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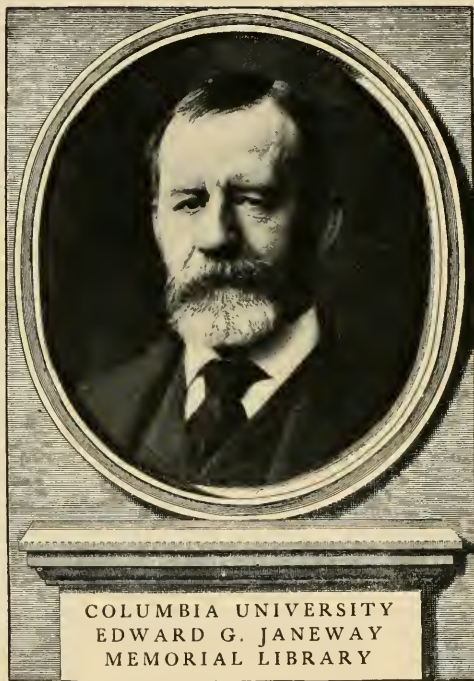


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# THE RADIOGRAPHY OF THE CHEST

Vol. I.

## PULMONARY TUBERCULOSIS

With 9 Line Diagrams and 99 Radiograms

BY

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*To My Wife*



## PREFACE

DURING the present decade, the manufacture of more powerful installations, the improvement of special technique, and the gradual accumulation of knowledge, have greatly enhanced the value of X-ray examination in the diagnosis and prognosis of diseases of the chest. Nevertheless, it is always expedient to check and compare the results by means of the usual methods of investigation ; although, on the other hand, in many instances radiography alone has proved *absolutely decisive*. The real foci of disease may be concealed by superimposed shadows, or by the persistent sequelæ of obsolete lesions. Consequently, the *correct interpretation* of pulmonary opacities may become a very difficult problem, and necessitate the exercise of expert clinical skill as well as a wide radiological experience. For this reason, the data of physical examination have been summarised and included, whenever possible, throughout the book.

I have attempted to describe the majority of the types of pulmonary tuberculosis, with the commoner localities of incipient disease, and have adopted, for this purpose, a radiological classification which is personal and provisional. In order to anticipate criticism, I may emphasise the great complexity of the subject and the impossibility—in the absence of anatomical control—of placing accurately many intermediate forms. For instance, examples of perihilar nodal tubercle may assume a pseudolobar expression ; cases of mild diffuse fibroid are in reality attenuated, often arrested ; whilst some of those depicted under the heading of *minor phthisis* might have been included, with almost equal justice, in the following chapter on fibroid affections of the lung.

The large number of radiograms—permitted by the generous consideration of the publishers—has rendered it more convenient to devote this volume to the description of pulmonary tubercle alone ; in the second, non-tuberculous diseases of the lung and affections of the heart and aorta will be discussed. With the exception of a few woodcuts and radiograms—mentioned below—the illustrations are original. Some have been taken at the City of London Hospital for Diseases of the Chest, others at the East

Sussex Hospital ; a few are selected from patients sent by medical friends. Reproduction has been allowed by the medical staffs and by local medical *confrères*. I seize this opportunity of recording my very grateful thanks. Of the woodcuts, 2, 3, 4, 6, 9 are after Rieder, Schut, Pièry, and Besançon ; radiograms 4, 5, 65B, and 68 have been enlarged from Assmann.

A list containing standard text-books and periodicals of cognate literature is given in the Appendix. Pièry's "Manual," I may mention, has been of great assistance, from the clinical point of view, in the preparation of Chapter VII.

WALKER OVEREND.

St. Leonards-on-Sea.

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# RADIOGRAPHY OF THE CHEST.

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## CHAPTER I

### THE NORMAL CHEST.

THE general principles of X-ray technique are described in British text-books of radiology; nevertheless, it may be advantageous to make a few remarks referring exclusively to the examination of the chest. For radioscopy, as well as radiography, soft X-ray tubes with tungsten targets should always be employed. The best degree of softness is between 6 and 7 Bauer; the milliamperage for the radioscopy being about 2 to 3, the diaphragm of the tube-box being contracted down for examination of the apices, the hila or any abnormal opacity. For radiography the milliamperage should be from 7 upwards. The exposure is made in moderately deep inspiration, in a condition of complete immobility, and should not last longer than from 5 to 10 seconds. It is possible, by means of intensifying screens and massive ampèrage, to reduce this period to the fraction of a second; but such pictures may not be entirely free from grain, and the finer details then become invisible. The distance of the fluoroscopic screen from the target should be from 20 to 24 inches, and for a complete photograph plates of 15 in. by 12 in., or 12 in. by 10 in. are necessary. For the oblique diameters and the apices plates of 10 in. by 8 in. may be sufficiently large. Stereoscopic pictures of the varied diameters may be made in the usual manner; it is preferable, however, to remove the target two inches towards the diaphragm and cardiac apex for the second radiogram, and to view the plates

laterally on the stereoscope. In this way the whole chest, is more easily obtained on the radiogram.

When a complete radiological investigation of the chest is made, several principal or cardinal positions are selected but the one most generally useful is the *anterior* or *dorso-ventral*; the rays entering the chest from the back, with the anode at the level of the junction of the fourth costal cartilage with the sternum, and the fluorescent screen placed over the front of the chest. With feeble invalids the recumbent posture is preferable, although the upright or sitting position possesses several advantages and sometimes is indispensable. The image on the screen presents three distinct areas, one median and two lateral. The median zone is dark, and increases in breadth towards the left side of the patient from above downwards. It is termed the *median shadow*, and is produced by the summation of opacities due to the greater densities of the vertebral column, heart, great vessels, and the sternum. The lateral areas are the *right and left pulmonary fields*. These are bounded on each side by the ribs and below by the diaphragm. The fields are roughly triangular in shape, and are crossed by the shadows produced by the ribs, which run obliquely from above downwards, so that the anterior portions of the higher ribs intersect the posterior opacities of the lower. Since the cartilages of the ribs are transparent to the rays, there is a gap between the anterior osseous extremity of each rib and the sternum. As age advances calcification of the first rib cartilages is common; also the same process is often seen in the form of linear opacities running along the upper and lower borders of the cartilages of the lower ribs. Each pulmonary field is divided into two unequal parts by the horizontal opacity due to the clavicle. The lower border or diaphragm consists of two arches (with the convexities directed upwards) which rise and fall with the movements of respiration.

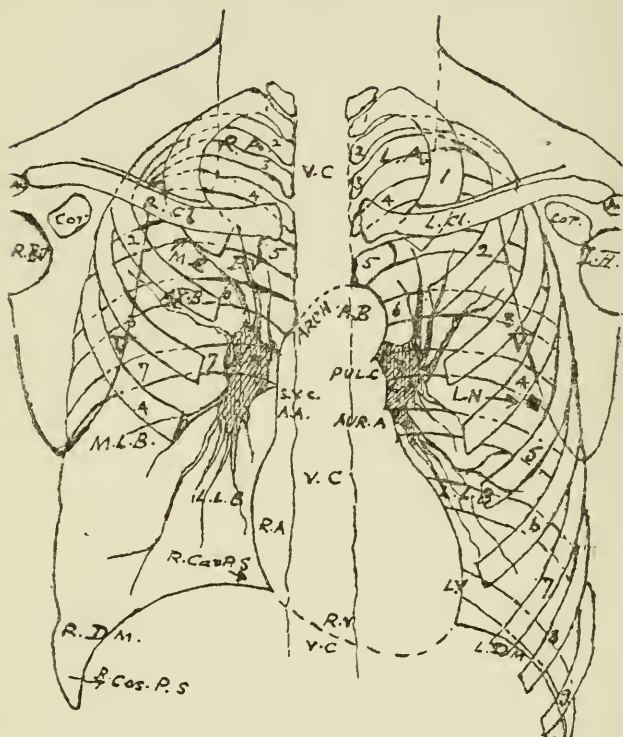
The *outlines of the heart* are visible outside the shadow

of the vertebral column, commencing about one inch below the sternal ends of the clavicles. On the right the margin is practically straight; the upper two-thirds correspond to the ascending aorta and the superior vena cava; the lower third to the right auricle. On the left three rounded projections may be more or less in evidence. The upper corresponds to the bend of the aortic arch as it passes backwards to become the descending arch and descending aorta. It has been termed the *left aortic bulge*. As age advances it becomes more pronounced and tends to reach the level of the sterno-clavicular joint. The middle eminence denotes the position of the pulmonary artery, and the lowest and largest is formed by the left ventricle. In certain diseases, as in mitral stenosis, hypertrophy of the left auricle is seen to produce an intermediate convexity between the pulmonary artery and the left ventricle.

Closely connected with the median shadow is that of each *hilum* or root of the lung, of which the right is the more conspicuous, the lower part of the left being concealed by the cardiac opacity. Between the right hilum and the heart a clear space is occasionally seen, which corresponds in position with the branch of the right main bronchus running towards the diaphragm. Each hilum with its upward and downward prolongations presents the form of a crescent. By slight rotation of the patient to the right, or by elevation of the screen a foot from the chest, a better radiosopic picture of the right hilum is obtained. In good radiograms the branches proceeding from the hilum may be followed upwards, outwards and downwards, and it is seen that they subdivide and finally produce a retiform appearance towards the periphery, which has been termed the radio-structure of the lung.

The shadow of the right dome of the diaphragm lies higher than that of the left. In ordinary quiet respiration the curve of the convexity remains the same both in descent and ascent. At the inner extremity between each cupola and the heart lies the *cardio-phrenic sulcus*. In deep

DIAGRAM I.

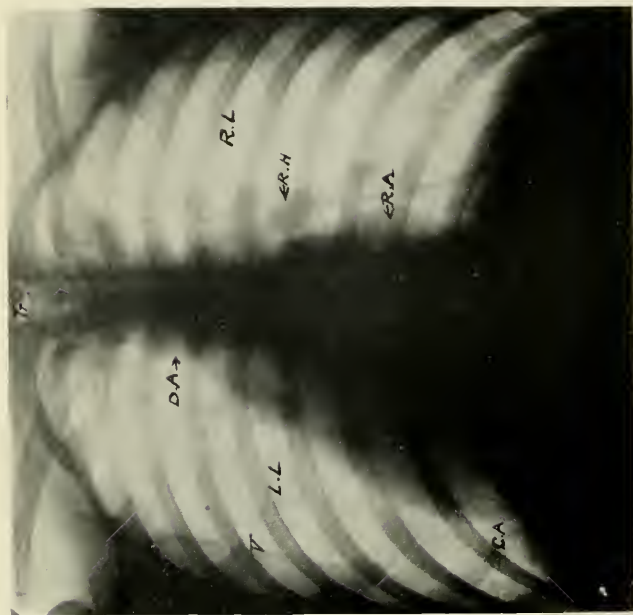


Chest.—Anterior or dorso-ventral view. For the sake of clearness the lower ribs on the right side are omitted.

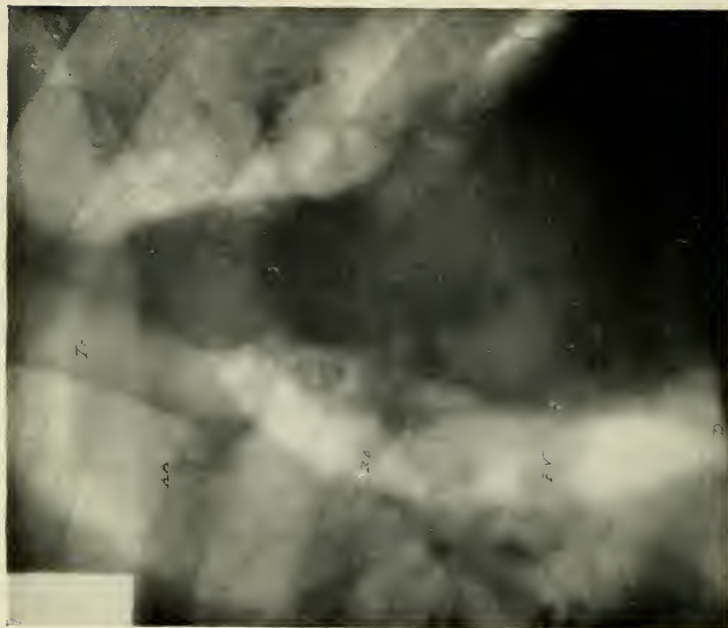
Heart.—R.A., right auricle; R.V., right ventricle; L.V., left ventricle; Aur.A., position of auricular appendix; Pul.C., pulmonary artery; A.B., left aortic bulge; S.V.C. and A.A., superior vena cava and ascending aorta.

R.A., L.A., right and left pulmonary apices; R.Cl., L.Cl., right and left clavicles; Cor., coracoid process of scapula; Ac., acromion; L.H., humerus; L.N., left nipple; L.H., R.H., right and left hila; P.V., para-vertebral; MC., mid-clavicular; Ax., axillary bronchi of upper lobe; M.L.B., chief bronchus of right middle lobe; L.L.B., bronchi running to lower lobes; V.C., vertebral column, the figures refer to the number of rib, vertebral and sternal portion; R.D.M., L.D.M., right and left phrenic leaflets; R.Car.P.S., right cardio-phrenic sulcus; R.Cos.P.S., right costo-phrenic sulcus; V. vertebral border of scapula.





RAD. 1.—Normal chest (posterior). L.L., left lung; R.L., right lung; D.A., left aortic bulge; R.H., right hilum; R.A., right auricle; C.A., cardiophrenic sulcus; V., vertebral border, left scapula; Tr., trachea.



RAD. 2.—Right anterolateral radiogram. A.A., aortic arch; Tr., trachea, with rings visible; R.B., right bronchus; P.V., pulmonary vein; D., diaphragm; R.B. and P.V. lie in the retrocardiac space.

inspiration, when the diaphragm descends, the sulcus widens, and occasionally completely separates the shadows of the heart and the central tendon. At times a fine shadow is visible within the sulcus on either side of the heart, which is the expression of the pericardial sac. At the *outer* extremity of the diaphragm, between it and the ribs, lies the *costo-phrenic sulcus*, obliteration of which is produced by adhesions and thickenings of the pleura, or by the presence of small pleural effusions. To see the latter the upright position is necessary. (Diagram 1.)

The *posterior or ventro-dorsal* position is obtained by arranging the tube in front and the screen on the back. It is the reverse picture, the apex of the heart now lying to the left side of the observer. The shadows of the posterior divisions of the ribs stand out more prominently, but they appear thinner and the interspaces narrower than in the anterior position because they are nearer the screen. The lower border of the rib presents an overhanging margin, 3 to 4 inches long, best seen in the 7th to the 9th, which corresponds to the costal groove, *sulcus costalis*, and lodges the intercostal vessels and nerve. On the other hand, the cardiac outlines are less sharp and the opacity is larger. The vertebral border of the scapula is more obvious (Radiogram 1), and can easily be identified by movement of the upper arm. The excursions of the diaphragm and changes of the costophrenic sulci are easier to follow. When a radiogram is taken it is preferable to fix the target at the level of the fifth dorsal spine. Although this view is not so generally used as the former, it cannot be omitted, since many lesions, especially those of tuberculosis, often lie nearer the posterior surface and are therefore more accessible to the screen and plate in this position.

The *right antero-lateral or oblique posture* is obtained when a patient in the anterior or dorso-ventral position is slowly rotated from the left to the right of the observer, until the right mammary line comes into contact with the screen.

The rays then penetrate the chest, from behind forward, obliquely at an angle of about  $45^{\circ}$ . If recumbent, the left hand may be placed under the head and the right arm drawn away from the side and supported by an air cushion. A sand-bag applied below to the back will steady the chest. In practice it is unnecessary to employ this angle exactly; it is sufficient to move the patient gradually with the help of the screen out of the anterior position, until the median shadow, consisting of sternum, heart and vessels, is thrown forward from the vertebral column, and the best picture obtained. Three clear zones (Radiogram 2) are distinguishable; the right is the left pulmonary field; the middle small mediastinal area is limited by the heart and aorta in front, the vertebral column behind, and is partially covered by both pulmonary fields; the third bright area on the left is the right pulmonary field. The heart itself appears triangular; at the apex lies the arch of the aorta, the base is formed by the right ventricle and diaphragm. The vertebral border of the heart is constituted below by the right auricle, above which a less definite middle portion consists of left auricle, although the pulmonary vessels and superior vena cava participate. Above this lies the ascending aorta. If the descending aorta is sclerosed, as is often the case in hypertrophic emphysema, the continuation of the arch may be followed over the vertebral column. In deep inspiration the posterior mediastinal zone brightens, the diaphragm descends, and the inferior vena cava may be seen in the cardio-phrenic sulcus. The left side of the cardiac triangle consists of ascending aorta, the conus arteriosus of the pulmonary artery, and the left ventricle. Sometimes the left auricular appendix is visible. Between the aorta and vertebral column is the retrocardiac space, which is occupied by the trachea and œsophagus. The former cuts the shadow of the arch and produces a sharp contrast. The left bronchus and one or more of its divisions may be followed through the shadow of the ventricle; the right bronchus towards the spine, and the



RAD. 3.—Left anterolateral radiogram. A.A., aortic arch; L.B., left bronchus; P.A., pulmonary artery; Tr., trachea.



bifurcation space is defined. Occasionally the left carotid in front, and the innominate artery behind may be recognised. The right oblique diameter is useful for the determination of dilatation of the aorta, aneurism of the arch and descending aorta, and for the recognition of dilatation of the left auricle. Also it is necessary for the diagnosis of enlarged bifurcation glands, for mediastinal growths, and for the determination of lesions of the œsophagus by the aid of bismuth paste. Above the clavicle, in front of the dorsal vertebræ, opacities due to the presence of endothoracic goitre may be visible.

In the *left antero-lateral or oblique* attitude the patient is rotated in the opposite direction, that is from right to left, (observer). The same three bright zones are obtained, due to the right lung on the left and a median mediastinal division. The heart is more rounded in outline; its vertebral border is made up of left ventricle and left auricle, and on the sternal side the right auricle (Radiogram 3). In the sclerosed aorta the arch curves like a broad hoop over the dark cardiac opacity and the aorta descendens disappears within the shadow of the spine. Small pulsating opacities above the arch, which occasionally materialize on the plate, are the innominate, left carotid, and left subclavian. A pulsating ductus Botalli should be visible in this diameter below the arch and between it and the pulmonary artery.

The *left posterior oblique* (postero-lateral) diameter is obtained from the posterior or ventro-dorsal position by rotating the patient until the left shoulder blade comes into contact with the screen. The diameter is selected which gives the greatest breadth of the posterior mediastinal space. This position is also employed for the determination of the calibre and integrity of the œsophagus by means of bismuth and for the diagnosis of aneurism of the descending aorta.

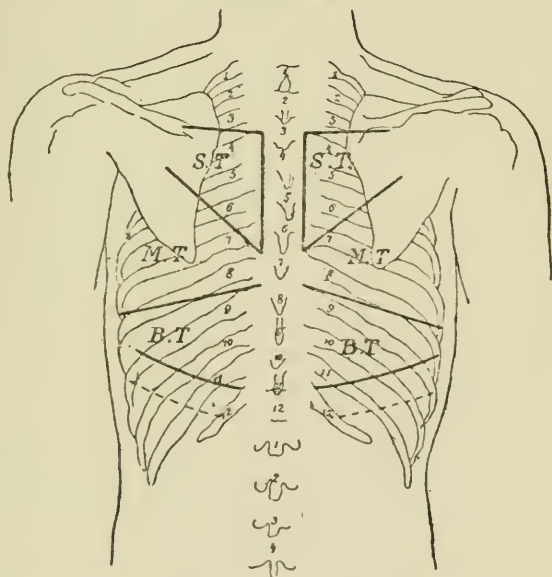
The *left lateral examination* is made by placing the screen on the left lateral aspect of the patient. The best results.

are obtained in thin individuals and in deep inspiration. The heart lies close to the screen, leaving a clear retrosternal space above, and a retrocardiac space below. The cardiac apex appears close to the thoracic wall. The descending aorta in thin elderly individuals may be visible, particularly if dilated or aneurismal. Small effusions of the pleura are visible in the retrocardiac space. The retrosternal space also widens during inspiration, the upper portion of the heart moving slightly backwards, while the viscus, as a whole, is drawn downwards by the crura of the diaphragm. In this position the antero-posterior diameter of the heart may be measured by orthodiagraphy.

In the anterior and posterior positions a general idea is obtained as to the increase of illumination during inspiration, of the movements of the ribs and diaphragm, and the existence of local abnormal opacities, which may or may not become less opaque during the same phase of respiration. Special attention must be directed towards certain areas, as the apex, the hilum, the fissures, the diaphragm and its sulci. The apex of the lung is bounded above and laterally by the first and second ribs, internally by the vertebral column, and below by the clavicle. Since the latter, however, is not a fixed line, but moves with the shoulders and during inspiration, it is preferable to select as the lower boundary a line drawn horizontally at the level of the junction of the fourth rib with the spine. In anterior pictures the shadow of the apex is partially concealed by the opacities of the first rib and clavicle. Well developed muscles of the neck, as the sternomastoid and sternothyroid, impair the illumination of the inner half. The presence of indurated supra-clavicular glands and of an endo-thoracic goitre may also produce a cloudy appearance. It is well, therefore, to palpate carefully the supra-clavicular triangle in every case before screening the area. The apices are less clear than the rest of the lung, and they exhibit only a very slight difference in inspiration and expiration, since they are aerated only by the descent of

the diaphragm and the pull of the crura upon the hilum of the lung; when the patient coughs, both apices should expand and appear brighter. Some apices appear large; in these, as a rule, the ribs run steeply and possess larger interspaces. The size is also dependent on the position of the X-ray tube. They are smaller when the tube is exactly beneath; larger when the target is at the level of the tendon of the diaphragm, or a few inches above the apex in the

DIAGRAM 2.



Radiological Triangles.—S.T., Subclavicular; M.T., Middle Triangles or the Wings; B.T., Basal Triangles.

cervical region. In both posterior and anterior radiograms the first interspace is often invisible. If the upper border of the lung on the radiogram falls within the shadow of the rib it is not seen. Often it is visible, however, as a faint narrow opacity running along the lower edge of the second rib. According to some radiologists, when the first interspace is visible the clear area is not due to lung, but to the effect of contrast between soft muscular tissues

and the shadows of the first and second ribs. That this is not the case may be deduced from the following observations: in posterior radiograms, especially in women, with some amount of emphysema of the upper lobe, plates may be obtained in which the shadow above described runs along the lower border of the *first* rib, and others in which the shadows produced by the reticulum of the lung may be followed into the first interspace, to become connected with small round areas which are obviously peribronchial apical foci. In children it is usual to see a fair-sized first space in posterior radiograms taken during deep inspiration.

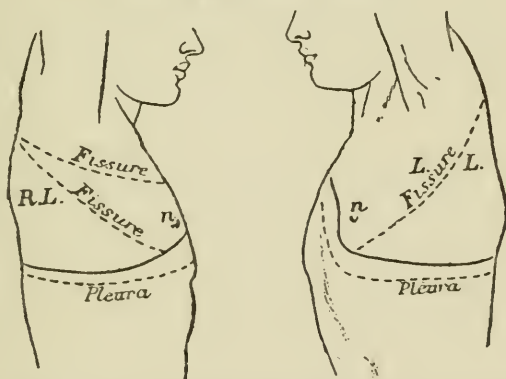
*The fissures of the lung.* (Diagram 3.) The great fissure begins at the upper part of the hilum, ascends slightly on the vertebral surface of the lung, and reaches the posterior border about three inches below the highest point of the lung at the upper margin of the vertebral end of the fourth rib. It runs spirally downwards and outwards, crosses the fifth rib in the axillary line, then forwards to the base of the lung, reaching it a short distance behind its anterior end, where it turns up and ends in the hilum. The secondary or horizontal fissure, only present in the right lung, leaves the great fissure at the fourth rib in the axillary line and runs horizontally along it towards the sternum, where it turns back along the mediastinal surface of the lung to the hilum. It lies above the nipple, but it may be absent, abnormal in position, or so adherent as to be separated with difficulty. A shadow seen at the level of these fissures may indicate interlobar thickenings of the pleura or an interlobar empyema.

*The hilum* lies opposite the vertebral ends of the 5th, 6th and 7th ribs, and is about  $1\frac{1}{2}$  inches broad. In the anterior radiograms, its external border lies well within the space left between the osseous extremities of the 2nd and 4th ribs and the mediastinal shadow. The opacity is a summation of shadows due to the pulmonary vessels and lymphatics, with the bronchi and a certain amount of connective tissue. It increases in extent and intensity of

opacity with age; it is more conspicuous in town dwellers and those who work in a dust-laden atmosphere (pneumoconiosis).

*Divisions of the lung.* In order to facilitate the description of the pulmonary field, it has been divided into areas by selecting certain more or less fixed points and connecting these by straight lines. By drawing a paravertebral line (where the heads of the ribs join the vertebræ) from the 4th to the 8th, and another from the 8th to join the horizontal line at the level of the head of the 4th in the axilla, we obtain a *subapical* or *subclavicular triangle* within which

DIAGRAM 3 (after Piéry).



Showing the position of the interlobar fissures, and the limits of the pleura in the right lateral and left lateral positions; R.L., right lung; L.L., left lung; N., nipple.

lies the seat of election for adult pulmonary tubercle; the great fissure traverses the outer and upper part. It also contains the first and most of the second anterior intercostal spaces. Another line is drawn from the head of the 8th rib along its shaft to the outer margin of the chest, producing a *middle triangle* or wing, within which are to be sought the foci of broncho-pneumonia in children, changes due to gangrene of the lung, and the first signs of miliary and perihilar tuberculosis. The basal part of the lung, thus separated, is the diaphragmatic area in which small pleural effusions and basal emphysemata are

found and almost all adult bronchiectases. It corresponds with the distribution of the lower bronchus (Diagram 3).

*Injections of the arteries or of the bronchi* may be made separately with substances opaque to the rays; the ramifications of each system will then appear as opaque dendriform shadows on the fluoroscopic screen, and may be radiographed. The trachea and the bronchial tree may be injected *in situ*, or after removal with the lungs from the cadaver. In order to control the flow it is necessary that the injection should be semi-fluid; since, as a rule, only the larger branches of the chief bronchi are required. For this purpose the author finds an emulsion consisting of equal parts barium sulphate and vaselin the best. Stereoscopic pictures are then combined and the distribution of each branch is readily recognisable. (*Vide infra*, page 14.)

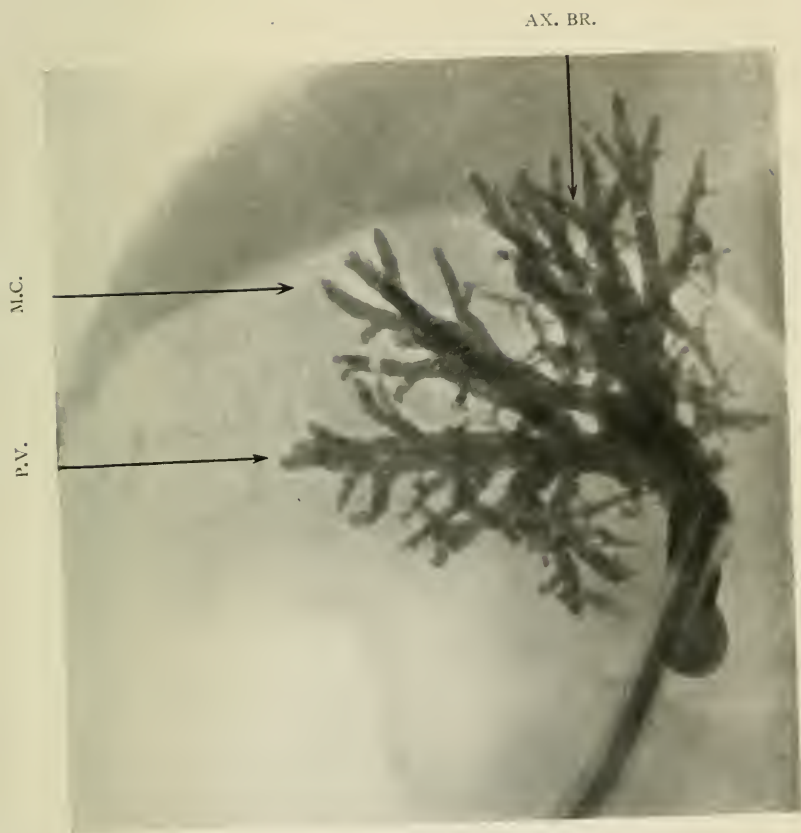
*The pulmonary reticulum.* On good radiograms, taken with short exposures, a network of threads is visible in the peripheral and lateral parts of the lung, which must either be due to structures containing a less amount of air, and therefore interposing some resistance to the penetration of the X rays, such as *blood and lymph*, or the *connective tissue walls* of the terminal and minute divisions of the bronchi themselves. Passing centripetally, these linear shadows become thicker and more obvious, and approaching the hilum they become heavier trunks, assuming the form of bronchial and vascular ramifications. The actual anatomical substratum to which the above tracery is attributable is still a matter of doubt and discussion. Is it due to the arborisations of the bronchi, or of the blood vessels, or both? Attempts have been made to solve the question by the injection into the bronchi or blood vessels of substances, like emulsions of bismuth carbonate, which absorb the rays, and by the subsequent comparison of the pictures obtained with those of the normal. From these experiments the only conclusion to be drawn, with regard to the course and pattern of the picture, is that either

might have been responsible. In pulmonary radiograms of the cadaver the lung tracery is much less pronounced than in the living subject, and must be attributed to the deficient distension of the vessels, as well as to the absolute stagnation of the fluid which may still remain within the veins and lymphatics. In opposite conditions during life, such as in the passively congested lung of mitral stenosis, the arborisation is more obvious than usual. When we consider the difference of structure between the two systems of ramification, the vessels, being airless, should show a compact solid shadow, whereas the bronchi, being tubes filled with air, should appear, if cut longitudinally, as clear streaks with a double contour. In the diffuse bronchiectasia of children, after pertussis, we meet with such pictures in all parts of the lung, especially towards the base and costophrenic sulcus; moreover, optical transverse sections are visible as minute circles with clear centres. This obscurity of the rim or circumference of the tube is emphasised when the walls are thickened by connective tissue proliferation, such as occurs in chronic bronchitis with emphysema, in the earlier stages of pulmonary tuberculosis, and in quiet extensive peribronchial phthisis. The nearer the periphery is approached, the more pronounced do the interweavings and intercrossings of the two systems become, so that finally a confused entanglement is produced which it is impossible to interpret. Most radiologists are now of opinion that both sets of arborisation play a part in the production of the network, but that the influence of the bronchi is more pronounced in the central parts of the lung; that of the blood vessels is more apparent at the periphery. In good soft radiograms of the lung, taken some days after a copious hæmoptysis, occasionally the seat of the hæmorrhage may be determined by the presence of an excessive number of fine shadows, without central lumina, connected with a caseous focus and situated often in the upper posterior areas of the lung. The lines are not so finely cut as in the

bronchi, since the column of blood is never still. The solution of the problem, to some extent, possibly lies in the quality of the tube. Soft rays will portray the vessels better, slightly harder the bronchi, whereas still harder rays will delineate more exclusively the ribs and the spine.

*The right bronchus* gives off an apical or eparterial branch, which divides into (a) anterior, (b) posterior, and (c) ascending branches to supply the upper lobe. On radiograms of emphysema with thickened bronchi, we can easily make out three chief sets of branches; paravertebral to the apex, mid-clavicular, and axillary, the mid-clavicular being supplied by posterior branches of (a) and (b), the axillary by anterior branches of the same. The main bronchus then gives off a ventral branch to the middle lobe (which is often visible just beneath the anterior end of the 4th rib), a dorsal to the apex of the *lower* lobe, then ventral (one of which goes to the azygos lobe) and dorsal branches to the rest of the lower lobe. (Rad. 3a.)

*The diaphragm* arises from the margin of the lower thoracic aperture in two main divisions, (a) *the sternocostal*, from the inner surfaces of the costal cartilages of the lower six ribs and the back of the ensiform process, the fibres passing backwards as they ascend, and (b) *the crural*, from the front of the bodies of the upper two or three lumbar vertebræ and the arcuate ligaments, to the posterior part of the central tendon. The right and left domes are supported and their curvatures preserved by the elastic traction of the lungs; the central tendon by means of its connection with the pericardium, the latter being continuous above with the deep cervical fascia and also attached by ligaments to the back of the sternum. To measure the height of the diaphragm, Professor Keith suggested a horizontal line drawn at the level of the junction of the body of the sternum with the ensiform cartilage (meso-metasternal line, Dally). In the normal thorax this line crosses the 5th cartilage, in emphysema it crosses below this cartilage; if the ribs are depressed, as



RAD. 3A (Ant.)—Main bronchus of left upper lobe injected with an emulsion consisting of carbonate of lead and vaselin; P.V., paravertebral ascending branches; M.C., mid-clavicular branches; Ax. Br., branches to axillary area and lateral wall.



in the habitus phthisicus, it crosses above the cartilage (*Journal of Anatomy and Physiology*, Vol. XLII). But since the meso-metasternal junction is not a fixed point, it is preferable to select the line drawn horizontally at the level of the junction of the 10th rib with the spine (Dickey).

In expiration the lateral muscular zone of the diaphragm lies in contact with the thoracic wall. During inspiration the enlargement of the lungs below is assisted by abduction of the floating ribs produced by the contraction of the quadratus lumborum and deep costal muscles. The viscera and intra-abdominal pressure play an important part in the determination of the movement of the diaphragm, by preserving the abduction of the lower ribs and furnishing a fixed point for its sterno-costal fibres. When there is a large gastric air sac, one may sometimes see, on the radiogram, the left crus passing to the tendon.

The intra-abdominal pressure assists the elastic traction of the lung in the recumbent, but is opposed to it in the upright position, the weight of the abdominal viscera also exercising a tug upon the diaphragm. The condition of the abdominal muscles is also important, that is, whether they are strong and capable of assuming a firm reflex tone in the erect posture. As determined by orthodiagraphy, in front, on standing the highest point of the dome lies at the upper edge of the 5th right and lower edge of the 5th left rib. In dorsal decubitus the dome may reach the lower edge of the 5th rib. *Behind*, on standing, the lower edge of the 9th right and 10th left; in the recumbent position, the lower edge of the 8th right and 9th left rib. In children the figures are somewhat lower; sometimes during deep inspiration almost the whole extent of the pleural sinus is occupied by lung.

In the horizontal position the diaphragm ascends nearly one inch, since the elastic traction of the lung is now assisted by the abdominal viscera. In right lateral decubitus, the right dome rises higher than in dorsal decubitus, and the heart sinks a little to the right. In left

lateral decubitus the left dome is less elevated than the right in right lateral decubitus, but in this position the liver produces considerable stretching and lowering of the right dome, so that the complimentary space or pleural sinus is almost entirely exposed on that side. In the lateral decubitus, therefore, the inspiratory depression practically only affects the dome of the side nearer the couch. The free side shows little or no movement, since its complimentary sinus is already laid bare, and the dome can scarcely descend any farther.

In quiet respiration both domes descend about half an inch. During the descent the costophrenic sinus and the convexity of the dome do not change in form. In forced respiration the excursion may reach one inch or more, whilst the costophrenic angle may descend as much as two inches. Deep inspiration is effected by increased action of the inspiratory muscles. For increased activity during expiration only relatively weaker muscular power is available; and the elastic force of the lung increases to a slight degree only. The expiratory position of the diaphragm is really not higher than in quiet respiration, indeed, it may be lower. This fact explains the origin of dilatation of the lung and emphysema as the result of increased inspiratory activity (*vide* page 87).

In young muscular adults, when repeated and forced inspirations are taken in the erect posture, the incipient depression of the dome may be immediately followed by a rise, which may assume a higher level than that of expiration. This normal paradoxical effect is accompanied by a depression of the epigastrium, and is explained by examination in the lateral position. The posterior part of the diaphragm is depressed, as usual, by contraction of the crura, but in the anterior and ventral parts the powerful elevation of the thorax carries with it the costal and sternal attachments of the diaphragm, so that the parietal portions of the latter appear even higher than the dome, even in the expiratory position.

When the diaphragm contracts, in the absence of activity of the intercostal muscles, as in faradisation of the phrenic, the pleural sinus is almost completely exposed. This is best seen on the right side. A similar condition is seen when the chest is held in a rigid position (rigid thorax) when the pleural sinuses become almost completely filled by the lung. This is accomplished by fixation of the costal and sternal attachments; the convexity of the domes becomes entirely lost.

The outlines of the mammary glands in the female are often visible on the radiogram; on the screen they may obscure the diaphragm and costophrenic sinus. They should be drawn upwards. A fine line running above and parallel to the clavicle is due to the fold of skin continued over the clavicle from the neck. In strong, muscular men, the lateral edge of the pectoralis major may often be followed to the sixth rib. The diminished opacity of cylindrical shape in the median upper part of the chest is due to the trachea. It is continuous with that of the right bronchus, and the latter may be followed as far as the hilum. The left bronchus is not so readily traced, since it passes in front of the descending arch of the aorta. Occasionally the *nipples* appear as rounded opacities in the middle of each field. (Radiogram 48.)

## CHAPTER II

THE CLASSIFICATION OF PULMONARY TUBERCULOSIS :  
TUBERCULOSIS OF THE BRONCHIAL GLANDS

A FEW introductory remarks concerning the varieties of pulmonary tuberculosis are necessary before undertaking a description of their prominent radiological features. On account of the polymorphism of the disease; of the propensity of the bacillus to create a *permanent nidus* within the pulmonary organs, and its disposition to invade the surrounding healthy tissues, insidiously and slowly, or widely and tempestuously, in accordance with the alternating phases of individual *resistance and susceptibility*—invasive attacks which are often followed by periods of relative or even perfect calm, during which the defences of the organism are remobilised, and the invalid, without symptoms and physical signs, may be *apparently* cured; on account of the variability in quality of the lesions, their mode of onset, and evolution, with the individual diathesis and period of life, and finally by reason of the possible occurrence of separate types in the same patient, even in the same lung, a satisfactory classification upon any absolutely rational basis appears unattainable. Certain interesting groupings of the disease may be mentioned, *e.g.*, that which records the method of onset (insidious, pyrexial, catarrhal, hæmoptoic, dyspeptic, enteritic, chlorotic, neurasthenic, dyspnœic, influenzal, bronchitic, bronchopneumonic, pneumonic, pleuritic). Again, Pégurier, of Nice (1903), introduced the factor of resistance, and classified phthisis into three principal groups: (*a*) with active and adequate, (*b*) with inconstant resistance, and (*c*) in which the resistance is nil. These classifications may suggest to the clinician the presence of the disease concealed under general manifestations, or may call atten-

tion to the connection between it and certain abdominal functional lesions, due apparently to reflex irritation of the enteric vagus,—occasionally hypersecretion, may be pyloric spasm from hyperacidity; in others rapid gastric evacuation, appendicular pain, and tachykinetic of the small and large bowel. Classifications based on (*a*) dyscrasias, such as gout, rheumatism, alcoholism, syphilis, and diabetes; and (*b*) on the period of life, such as infancy, adolescence, adult life, and old age, possess but a subsidiary utility; nevertheless, they may remind the clinician of the type of disease most frequently to be expected under the above conditions: for instance, in alcoholism, disseminated nodal disease with fibrosis; in diabetes, a rapid disease with large excavations, little pyrexia and expectoration, and possibly no night sweating; in gout, scrofula, and rheumatism, often a mild attenuated type. With regard to age, during infancy it suggests the prevalence of tuberculous bronchoadenitis, sometimes in the shape of large tumours; of acute bronchopneumonic nodal tubercle, generally of perihilar origin; of generalised miliary tuberculosis, and in the very young, of the acute caseating pneumonic variety; of apical disease, only after the second dentition and the approach of puberty, as a general rule; in adolescents, of galloping phthisis of different types; in middle life, of the various modalities of the fibroid lung; in old age, of the very slowly progressive fibroid cavitory forms, ending sometimes in subacute bronchopneumonic nodal, in pneumonic lobar, or in miliary localised dissemination. In the "Nomenclature of Disease" (Royal College of Physicians, 1918), pulmonary tuberculosis is divided into (*a*) acute, and (*b*) chronic. The acute disease is further subdivided into (1) miliary, (2) bronchopneumonic, and (3) pneumonic; the chronic into (1) caseous, (2) fibroid, and (3) fibrocaseous; each of the latter three with or without excavation. This clinico-pathological classification is unsatisfactory, since miliary, bronchopneumonic, even pneumonic, may become chronic; moreover, many cases

of caseous phthisis, included under the heading of chronic disease, may become rapidly acute.

Bard bases his classification on the anatomical and topographical distribution of the lesions, according to the particular pulmonary entity chiefly involved, *e.g.*, lobule, connective tissue, bronchus, and subpleural tissue ; that is, (a) *parenchymatous*, (b) *interstitial*, (c) *bronchial*, (d) *post-pleuritic*. Among the parenchymatous forms he differentiates :—

(a) Mild attenuated cases (apical cicatrices, etc.).

(b) Progressive forms.

1. *Caseating types*—

(a) Pneumonia caseosa.

(b) Pneumonia caseosa extensiva (phthisis galoppans).

2. *Fibrocateating type*, ordinary phthisis.

3. *Fibroid forms* (Chap. VI).

B. In the *interstitial* are included the miliary forms, viz., (a) general (generalisata); (b) localised (discreta vel benigna); (c) migratory (migrans), attacking several organs in succession; (d) suppurative; and (e) the typho-tuberculosis of Landouzy ("La Presse Medicale," October, 1908 and November, 1909).

C. In the *bronchial category* are included, (a) tuberculous capillary bronchitis; (b) tuberculous broncho-pneumonia; (c) tuberculous bronchiectasis; (d) bronchitic or asthmatic phthisis, with emphysema.

D. In the *post-pleuritic division* are included fibroid as well as fibrocateating forms (Chapters VI and VIII).

In 1899, Turban introduced a classification based on (1) the extent, and (2) the seriousness of the lesions, and distinguishes three stages, namely, (1) slight lesions reaching the magnitude of one lobe only at the outside; (2) lesions more extensive but not exceeding that of two lobes, or *severe* lesions affecting the extent of one lobe; (3) all lesions more extensive than 2. The area, corresponding to that of the right upper lobe, is selected as defining the extent

of *one* lobe ; it may be represented by the halves of two lobes, or the thirds of three lobes. By a mild affection is understood disseminated foci, with slight impairment of percussion note, weak breath sounds or harsh breathing, fine or medium râles. Severe lesions are represented by compact infiltrations containing excavations. At the International Congress, at Washington (1908), a modification of this classification was suggested. The stages again were three in number, of which in the first there are lesions limited to small areas of one lobe, for instance, not reaching below the spine of the scapula and the clavicle, if bilateral, bounded by the second rib in front if unilateral ; (2) areas more extensive but not exceeding the magnitude of one lobe, or a severe affection extending to half one lobe ; (3) all lesions exceeding the second degree, or with excavations. The difficulty of these classifications lies in the delimitation of the magnitude of the lesion by means of physical examination—this can only be done thoroughly by stereo-radiography—also, the precise extent of a lesion is no guide to its attributes, and the qualifications, slight and severe, are inadequate. Finally, no attention is paid to the perihilar lesions unmasked by radiography.

A further advance was made by Fränkel (1917), who distinguished :—

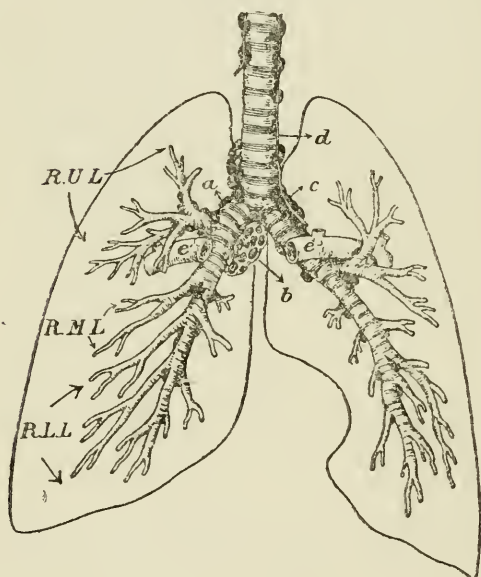
- (a) Indurative, fibroid healing examples.
- (b) Nodal peribronchial progressive cases
- (c) Caseative pneumonic or bronchopneumonic conditions.

In each case prognosis is rendered unfavourable by the presence of excavations. For the “closed” non-bacillary types the “plate” alone is *decisive* for diagnosis (Fränkel). From a pathological standpoint Nicol describes (a) *conglomerate*, and (b) *confluent* forms. In the former are included nodal and lobulo-bronchopneumonic, in the latter lobar pneumonic and lobar fibroid manifestations.

For the purposes of radiography the types of phthisis are now described in the following order :—

- I. Tuberculous disease of the bronchial glands.
- II. Disseminated nodular phthisis.
- III. Disseminated nodal phthisis.
- IV. Bronchopneumonic pseudo-lobar tuberculosis.
- V. Chronic attenuated phthisis.
- VI. Fibroid phthisis.
- VII. Pneumonic phthisis.
- VIII. Miliary tuberculosis.

DIAGRAM 4.

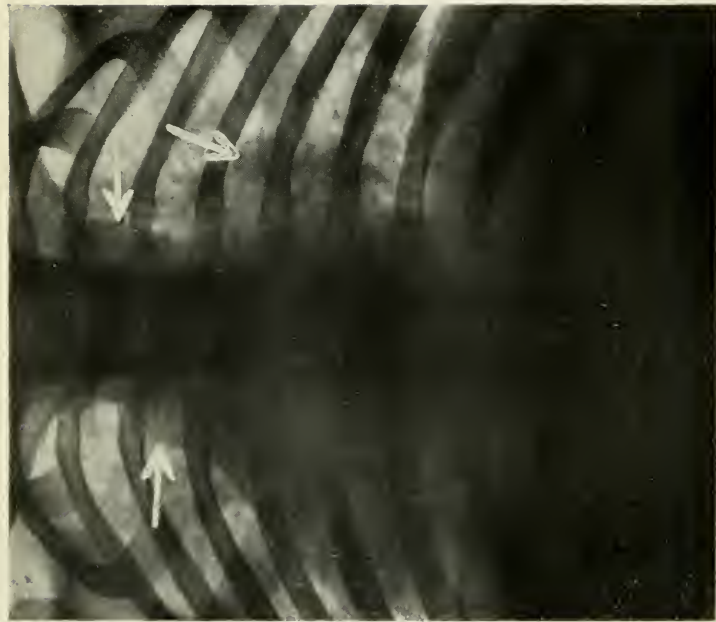


In Chapter VIII remarks will be found *re* post-pleuritic as well as bronchitic phthisis; and in Chapter IX on diagnosis observations concerning quiescent, arrested and quasi-arrested disease.

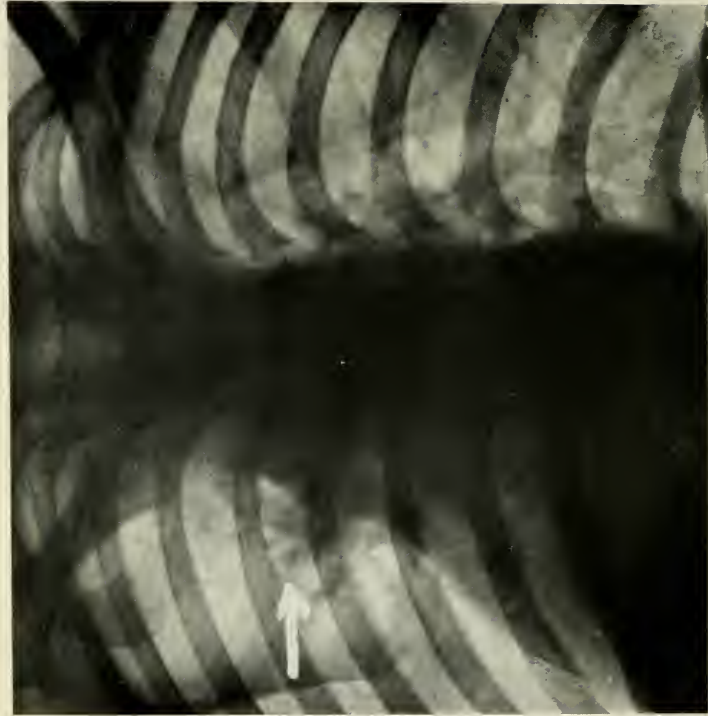
#### *Tuberculous Disease of the Bronchial Glands.*

The bronchial glands form the principal anatomical substratum of intrathoracic tuberculous infection in the latter part of the first and the earlier years of the second decade (5-15). Their general topography is indicated in



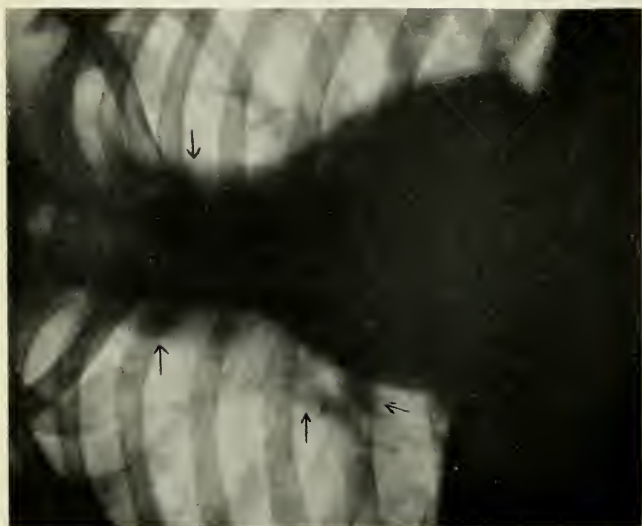


RAD. 4 (Post.)—Caseating tracheobronchial and hilar glands.



RAD. 15 (Post.)—Perihilar caseating foci, left hilum.





RAD. 6.—(Ant.) caseating tracheobronchial and hilar opacities.



RAD. 7.—(Ant.) caseating and calcareous foci in both lungs.

Diagram 4. It is seen that three groups are distinguishable: (*a*) mediastinal, (*b*) hilar, and (*c*) perihilar. The mediastinal group are again subdivisible into tracheobronchial (*a*, Diag. 4), and the bifurcation glands, (*b*, Diag. 4). The tracheobronchial, bifurcation, and hilar glands may be affected singly or simultaneously; lesions of the tracheobronchial and bifurcation glands may lead finally to the production of tuberculous mediastinitis. When hypertrophied and inflamed the glands become visible as faint shadows outside their topographical loci-opacities which become more intense when caseation or fibrosis subsequently occurs. The deepest contrast is exhibited when calcification takes place. Intrathoracic caseating glands form a continual menace to life; they are generally present in tuberculous meningitis, and in many instances they constitute the primary focus of this disease.

Of the various groups the bifurcation glands appear to be the most frequently affected. Their position behind the cardiac base conceals them in the anterior and posterior positions; in order to visualise and radiograph them the right anterior oblique diameter is necessary. On the radiogram, for the purposes of diagnosis the divisions of the trachea, that is the two chief bronchi, should be discernible with the opacity between them. The glands lie principally along the inferior border of the right extra-pulmonary bronchus, and are only separated from the right pulmonary artery by the pericardium. Posteriorly they lie on a level with the fifth dorsal spine. They receive lymphatics from the lower lobes and part of the right middle lobe. The left tracheobronchial (intrathoracic paratracheal) come into close contact with the left recurrent laryngeal nerve (*d*). They are separated, to some extent, from the main bronchus running to the left lung by the left branch of the pulmonary artery (*e*); on the right side, consequently, there is a more direct communication between the right tracheobronchial group and the right hilar glands and those situated along the bronchus

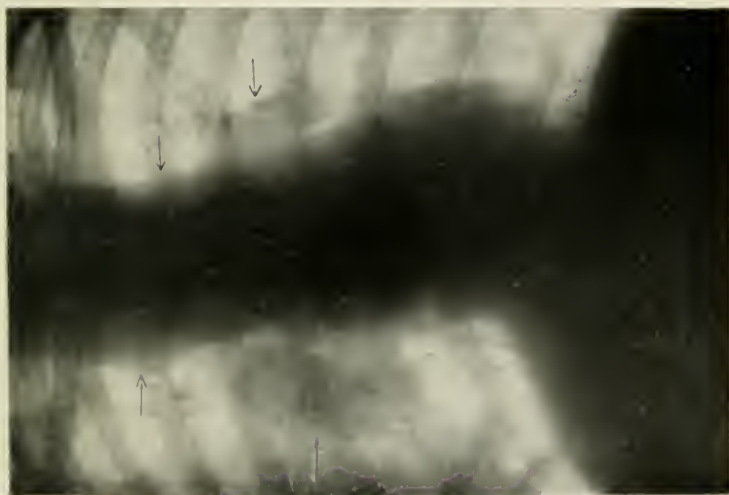
of the right upper lobe and its ramifications (R.U.L. Dig. 4).

CASE 1.—*Radiogram 4* (posterior). On the right of the spine, just beneath the sternal end of the clavicle, there is a dark shadow with a well defined border. In the right hilum a deep opacity containing a lighter area—the right bronchus. On the left, in the fourth posterior interspace, a convex shadow between the aorta and the left edge of the heart. *Post-mortem examination*: in the right hilum a number of caseating glands aggregated together; above the right hilum, overhanging the superior vena cava and the right innominate vein, a caseating gland—one of the tracheobronchial group, about the size of a walnut. Above the left hilum a gland about the size of a hazel nut, which surrounds the back of the left bronchus, and contains caseating and calcareous debris.

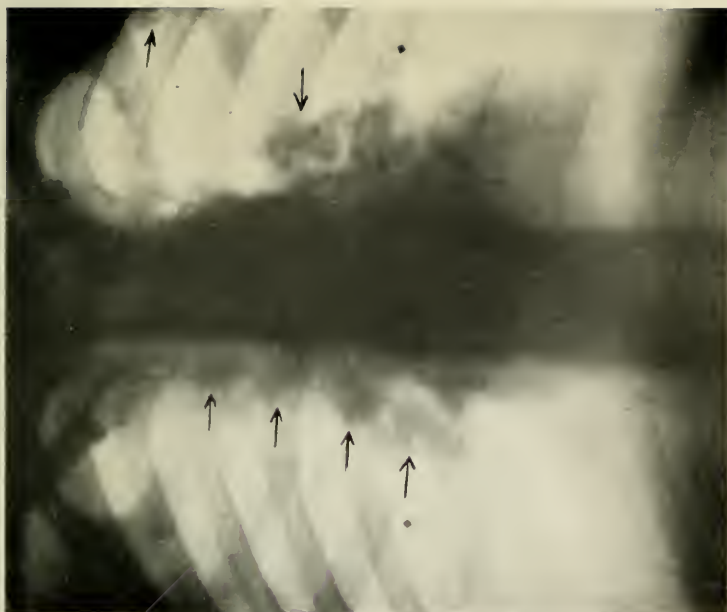
CASE 2.—*Radiogram 5. Clinical*: Percussion note slightly impaired at the right apex, otherwise clinical signs normal; diarrhoea, the stools containing tubercle bacilli. In the radiogram there is an opacity within the fifth left interspace near the cardiac shadow. Closely adjacent to it, within the fourth and sixth spaces, small foci are present with defined contours. *Diagnosis*: circumscribed induration (glands?) in the left hilum. *Post-mortem*: in the neighbourhood of the left hilum, and corresponding in position and extent to the shadows on the plate, indurated lung tissue is found containing small calcareous foci. In both hila several anthracotic and partially calcareous glands. The left hilar opacity is due to induration of the pulmonary tissue and not to diseased glands. The opacities surrounding it are produced by small indurated glands containing calcareous material. (Tuberculous foci and induration in the left perihilum.) For a similar case, *vide* Radiogram 44.

CASE 3.—*Radiogram 6. Florence T*—, æt. 12. *Clinical*: was in good health until three years ago, when the glands in the neck began to swell: there is cough: occasional night-sweats: hæmoptysis: physical signs within the lungs indefinite: right parasternal dulness (?). In the radiogram there are enlarged and caseating glands in the right paratracheal group: some increased shadowing within the right hilum, continued along the lower bronchus: a slight paratracheal shadow on the left side, and a few caseating glands in the left hilum.

CASE 4.—*Radiogram 7. Clara M*—, æt. 21: has suffered from cough for some years: since influenza, five months ago, it has been worse: expectoration scanty: wasting+: night sweats+: breath sounds harsh, right apex. Clinical diagnosis undetermined: The Radiogram shows polyglandular caseation and calcification. Outside the right border of sternum a faint shadow with an



RAD. 8 (Ant.) - Cascating tracheobronchial and hilar glands.



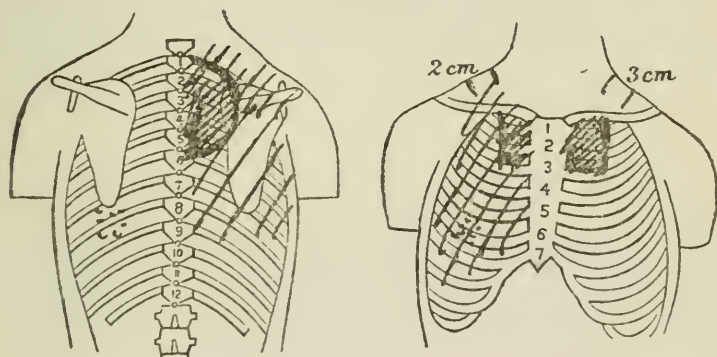
RAD. 9 (Ant.) - Fibrocalcating and calcareous tracheobronchial and hilar opacities (mediastinitis).



external limit running parallel with sternum, and containing within it deeper opacities: one marked caseating gland with calcareous spots (arrow) at lower part of right hilum: twin, calcareous opacities in right middle lobe near axillary lines (Ghon's primary focus?): some indurations along bronchi of right upper lobe: calcareous and caseating opacities at the left hilum, and one long cylindrical calcareous opacity at the level of left clavicle at its junction with the sternum. Phrenic leaflets uneven—irregular contraction of muscular fibres(?): some dilatation of the right auricle. A small lead disc over left nipple.

CASE 5.—*Radiogram 8.* Alice P—, æt. 16: suffers from cough and night sweats: is thin, anæmic: menstruation is delayed: there is no clubbing. *Physical signs:* right paravertebral dullness (Ewart)

DIAGRAM 5.



to percussion, and double parasternal (4 cm. on right, and 5 cm. on left—normal 2 cm.): both apical areas (Krônig) narrow, at this age normal is 4 cm.: breath sounds blowing at the right apex, in the upper back and down the spines to the third dorsal, with whispering pectoriloquy: breath sounds blowing at the left apex, but less than on the right: a few "crackles," on deep breathing, over the right base in front, and the left base behind: no other adventitious sounds: reflex bands of impairment to percussion (Riviere). *Clinical diagnosis:* tuberculous bronchoadenitis with some hilar tubercle. The radiogram shows enlargement and caseation of all the central groups of glands, right and left paratracheal, hilar, and in the right oblique radiogram the bifurcation glands. Some dissemination, and slight contraction of chest along the axillary lines in right upper and middle lobes. Some dilatation of the bronchi at the bases. Right supraclavicular apex somewhat darker than the left.

CASE 6.—*Radiogram 9.* Joseph Y——, æt. 12 : cough, dyspnœa, weakness: he has always been delicate: complexion pale: palpable glands are present in the axillæ, in the anterior and posterior triangles of the neck. These are firm and discrete: spleen just palpable: blood-count, 4,200,000 red: 10,800 white: hæmoglobin, 80 per cent: polymorphs, 53 per cent.: lymphocytes, 47 per cent.: small, 36 per cent. (lymphocytosis): (diminished polynucleosis and increased lymphocytosis characteristic of abortive, that is, attenuated tuberculosis): temperature, 97·6° to 98°: *Physical signs*: percussion note over *left* upper lobe impaired in front and behind: breath sounds harsh and expiration prolonged: vocal resonance increased: over the rest of the lungs breath sounds diminished, as well as the vocal resonance. The radiogram (anterior) shows massive hilar shadows, some containing dark granules (calcification): calcified glands in left axilla: convex paratracheal shadow below sternal end of right clavicle: and a smaller opacity below the left clavicle on the mediastinal border: glands obviously enlarged and fibro-calcareous. In right oblique diameter bifurcation opacities and glands along internal mammary also enlarged: tuberculous mediastinitis: some basal emphysema. A small leaden square on each nipple.

CASE 7.—*Radiogram 10.* Ethel G——, æt. 19: cough, night sweats, no hæmoptysis: *Clinical*: a few râles at right apex and superior angle of right scapula: distended abdomen, fulness in iliac fossa, and diarrhœa: stools not examined for bacilli. The radiogram exhibits horizontal ribs and emphysema: a slight costophrenic adhesion on the left (radioscope). The arrow points to the inverted comma, the prolongation of which upwards marks the right border of the trachea: the comma is evidently an enlarged often fibrosed tuberculous gland: there are slight paratracheal shadows on each side of the upper sternum, and some dissemination betraying itself by the presence of thin shadows in the peripheral fields, especially in the right costophrenic angle, and an opacity in the lower periphery of the right hilum.

CASE 8.—Miriam F——, æt. 28: has been confined to bed in hospital six months, with more or less continuous pyrexia, ranging between 102° and 99°: family history is negative: the illness commenced with rheumatic pains in the joints, which became swollen, and with diarrhœa: chest signs practically nil, with the exception of harsh breathing and prolonged expiration at the apices, and granular breathing, almost inspiratory crepitations in the right axilla, also marked basal annular emphysema. Emaciation extreme. The Radiogram (11) shows massive hilar shadows and fibroid infiltrations, especially on the left, and some pulmonary dissemination on both sides: a patch of fibro-calcareous opacity in the right axilla, not so well seen in print as in the plate: a few

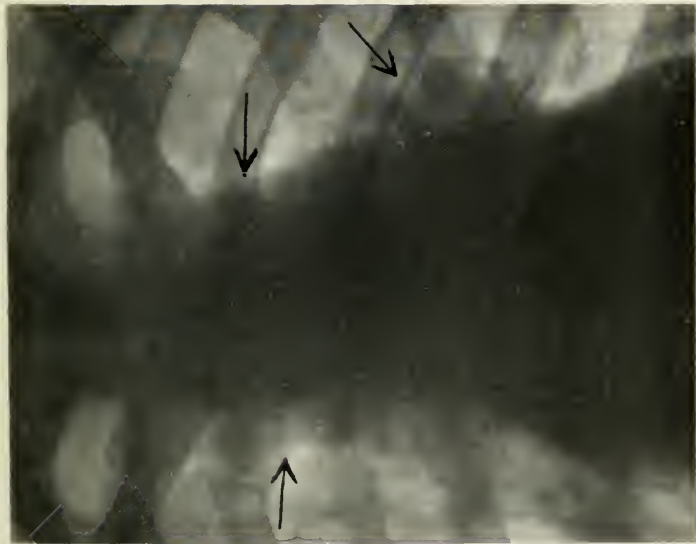


RAD. 10 (Ant.)—Quiescent tubercle. Crane's inverted comma (arrow) emphysema.



RAD. 11 (Ant.)—Tuberculous mediastinitis (quasi-arrested).





RAD. 12 (Ant.)—Paratracheal cascating opacities.



RAD. 13 (right oblique)—Highest arrow is tail of icomma. Middle arrow is tracheobronchial opacity. Lowest arrow is bifurcation opacity.



glands outside chest in right upper axilla, also not seen in print : and a few calcareous foci scattered irregularly in the apices and right middle lobe. The chest tends to the thorax paralyticus. The case raises the question of the relations between certain forms of rheumatism and tubercle (Poncet and Leriche). The association of granular breathing and fibro-calcareous deposits in the right axilla suggests that the former is not always a sign of incipient tubercle, but may really be an indication of arrested disease. The radiogram represents chronic tuberculous mediastinitis.

CASE 9.—Mary F——, æt. 25 : about six years ago suffered from apical trouble which healed : about three years ago, after measles, enlargement of the cervical glands began in the thyroidean region, and extended to the posterior triangle : these are painful and chiefly on the left side : the isthmus of the thyroid is enlarged : the eyeballs are prominent : Graefe's sign absent : pupils rather dilated and not very sensitive to light : double parasternal and right paravertebral dulness (Ewart) is present : no added sounds, except fleeting clicks at the right apex on deep breathing : there is slight bronchial breathing and increased tactile fremitus and vocal resonance at the axillary end of the right clavicle : a faint systolic bruit over third left interspace (anæmic) : pulse, 76-90 : blood pressure, 125 mm. : palpitation, flushes, and occasionally frontal headaches. The Radiogram (12) shows tracheobronchial opacities on each side : and infiltration of each hilum, especially the left, with some fibrosis of this side. The case is interesting, since it shows the revival of central tubercle, and of the glands in the neck, after an attack of measles, as a cervical and endothoracic adenitis. In the blood there is increased polynucleosis, and diminished lymphocytosis, indicating that tubercle is still in play. The enlargement of the thyroid, the tachycardia, the flushing and prominence of the eyeball suggest Graves' disease of a mild form. It is quite common to find an increased right paratracheal opacity, or the remains of a massive, almost general infection of the lung itself in subjects of this disease : occasionally attacks of exophthalmic goitre occur simultaneously with exacerbations of pulmonary tubercle : also in soldiers exhibiting the signs of hyperthyroidism, paratracheal shadows may be present. The relations between the two diseases are still obscure, and require further investigation. At least every case of exophthalmic goitre should be radiographed, and if the glands or the thymus are found enlarged, X-ray treatment should be at the same time administered to these structures.

CASE 10.—Robert P——, æt. 21, suffers from enlargement of cervical glands in both posterior triangles, especially on the left side, and both axillæ, and there is one large supraclavicular gland

on the left. The glands are firm: there is pyrexia and some wasting: *Clinical signs*: there is slight impairment of percussion resonance over the right chest front and back, and a right paravertebral dulness, with some fine crepitations at the right base. The posterior radiogram shows pleural thickenings at both supraclavicular apices, especially the left: a faint paratracheal shadow on the right side, otherwise the lungs are normal. In the right oblique radiogram (Radiogram 13) the faint paratracheal shadow is indicated by the middle arrow: the highest arrow points to the tail of the comma, which is evidently a thickened lymphatic, and here indicates the posterior margin of the trachea: the lowest arrow indicates the bifurcation opacity between the limbs of the main bronchi.

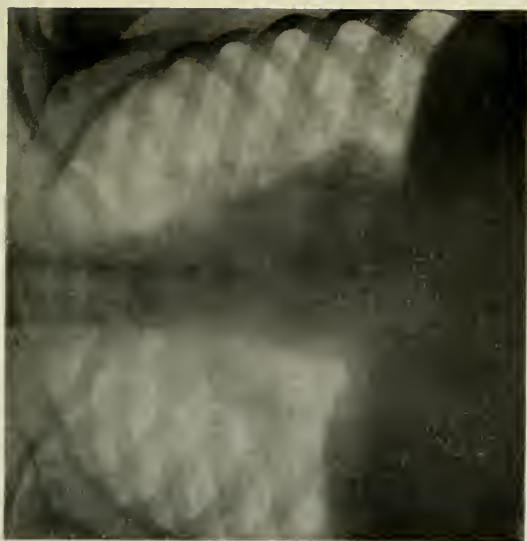
In very young children the central glands may become very large. Grace B——, æt.  $2\frac{1}{2}$  years: family history is negative: suffered from measles and bronchitis eight months ago, and has never been well since: there is a paroxysmal cough *without whoop*: no expectoration: loss of appetite: night sweating about the head: no pyrexia: temperature generally subnormal. *Clinical signs*: right apex, impaired note: vocal vibrations and resonance increased: bronchial breathing and crepitations: slight collapse of the right chest: child was discharged *in statu quo* after six weeks. *Clinical remarks*: "The diagnosis of collapsed upper lobe due to tuberculous mass of glands pressing on right upper bronchus unlikely owing to absence of stridor and the presence of added sounds: the clinical diagnosis therefore remains doubtful." Pirquet evidently not employed. Radiogram 14 (posterior) a large wedge-shaped opacity, apex below, is present along the right side of trachea and right bronchus (paratracheal), outside which, in the right upper lobe, there are signs of dilated tubes and slight infiltration. The left hilum shows an opacity of increased magnitude and intensity. On the right the shadow is uniformly opaque. *Radiological diagnosis*: caseating tracheobronchial glands on the right producing an opaque mass in the radiogram, and leading, by compression of right bronchus, to incipient fibrosis of right upper lobe. Bifurcation glands in the right oblique position unaffected.

Radiograms Nos. 15 and 16 are inserted in order to show the softening and final irruption of hilar caseating glands into the lung. This patient was kept under observation for about one year. The final dispersal, which produced an acute nodular bronchopneumonic tuberculosis, occurred a few weeks before death. The differential diagnosis of the various mediastinal and hilar opacities, such as are produced by mediastinal tuberculous, sarco-



RAD. 14 (Post.)—Caseating right paratracheal opacity.





RADS. 15 and 16 (Ant.)—Tracheobronchovascular and hilar opacities, followed by disseminated bronchopneumonic phthisis.



matous and carcinomatous growths, by enlargement of the thymus, by lymphadenoma, aneurysmal swellings, is discussed in Vol. II, in the chapter devoted to tumours of the lung and mediastinum.

*Clinical and Radiological Remarks.*—The above cases render it obvious that there are no clinical criteria of any value, and that the radiological examination is necessary for the diagnosis of tuberculosis of the bronchial glands. Difficult as it is, in the case of the child, in the adult it is more perplexing still. The simultaneous occurrence of several clinical symptoms may render the diagnosis suspect. These are partly due to pressure on bronchi, blood vessels, lymphatics, nerve trunks and plexuses, and partly due to the absorption of toxins produced by the virus. The glands, however, very rarely become tumours of sufficient size to produce marked pressure symptoms, unless very favourably situated, and some of these effects may in reality be due to reflex influences exercised on the external inspiratory muscles and the diaphragm. Very occasionally the bifurcation glands may become large enough to compress the œsophagus and induce difficulty of swallowing (one case—the author), or they may soften and become evacuated by this channel. Occasionally, enlarged paratracheal glands on the left compress the recurrent nerve, producing hoarseness and sometimes loss of voice; the paroxysmal cough may be due to compression of the vagus or to mechanical irritation of the lining of the chief bronchi and trachea near its bifurcation. In children it is usual to lay stress on the presence of whispering pectoriloquy in the paravertebral regions of the chest and dorsal spines; to signs of pain on pressure upon the spinal processes of the upper dorsal vertebræ, which may be *very* occasionally met with; to the presence of an increased Ewart's area of paravertebral dulness, and harsh blowing, or even weakened apical breath sounds, with perhaps an occasional click (œdema?) at the end of a deep inspiration.

With the formation of small areas of perihilar infiltration, crepitations may be heard at the level of the nipple, the hila behind, or these may be conducted to the axillæ and apices. In the majority of cases in children the dissemination is purely lymphatic, the lymph trunks become thickened, and the pulmonary glands enlarge, but remain *follicular*, and do not become infiltrative. It often corresponds to a general hyperplasia of the lymphatic glands, and is merely a passing phase of temporary loss of the powers of resistance, which, under proper treatment, rapidly disappears. Between the ages of 5 and 15 the immunity is generally sufficient to prevent any serious establishment of the disease. (*Vide Lancet*, Sept. 30th, 1917, Overend and Riviere.) When the presence of pulmonary tuberculo-adenitis in *the adult* is suspected, the presence of faint bronchial breathing, of râles, or sibili in the neighbourhood of the hilum, in front or behind, will make the diagnosis more probable. Especially will this be the case if the temperature is labile, with an increased reaction after work and exercise; if the pulse is of low tension and unstable, becoming easily accelerated; if there is a paroxysmal cough, and if the patient shows signs of anæmia, lassitude, or neurasthenia. The clinical signs may be due to a localised congestive bronchopneumonia, or actually to a hilar or perihilar tuberculosis. The probability, as in children, is in favour of the former. A good radiogram may prove illuminative, and is the only certain method of diagnosis.

Some of the cases in children of school age, as mentioned above, exhibit on the radiogram the presence of a general hypertrophy of the tracheo-broncho-pulmonary lymphatic tract, and quite small nodules may even be seen just beneath the pleura. There may be a fine narrow shadow running parallel to the sternum on the right, and both hilar areas assume a diffuse gray appearance. In addition, the cervical axillary (and possibly the mesenteric glands)

are enlarged and palpable. These are accompanied by malaise, anæmia, and later by amenorrhœa.

Hyperplasia of the central lymphatic glands, both in children and in adults, may be due to causes other than tubercle. Enlargement may accompany simple chronic bronchitis, lobular and lobar pneumonia, in particular that which accompanies measles and pertussis, also the rare adult form of fibrinous bronchitis, and certain neoplasms of the mediastinum. In some instances, as well as in mild tuberculous infections, the effects of forced inspiration during cough, aided by a presumed deficiency of elasticity in the pulmonary tissue, may be shown by the production of a generalised cylindrical bronchiectasia and of emphysema, with their proneness to attacks of recurrent bronchitis, and which, if the tuberculous contagion becomes negligible, assume the predominant features. The pressure of enlarged paratracheal and bifurcation glands on the bronchi may lead, as in other forms of compression, as those of neoplasm and aneurysmal swellings, to the production of pulmonary fibrosis beyond the seat of compression, and conversion of the offending mass into innocuous fibrous tissue will not necessarily restore the integrity of the upper lobe, which in the meantime has become cirrhotic and is occupied by dilated tubes. In other cases an unresolved basal lobular or lobar pneumonia may finally become fibrosed, then bronchiectatic, and this may be bilateral. A radiosopic examination at once demonstrates the presence of a basal triangular opacity, with its apex at the hilum and its base occupying all, or nearly all, one moiety of the diaphragm. It may be termed the *basal bronchiectatic fold or triangle*.

Cases of unresolved basal pneumonia, and of pure fibroid lung in children, are often sent to the tuberculosis dispensary to be treated as tubercle; they are, in reality, more common than the genuine affection. We return to this subject in the chapter on "Bronchiectasis" (Vol. II). It is obvious, however, that in patients suffering from general

cylindrical bronchiectasia the prescription of respiratory exercises may do more harm than good, if undertaken before the pulmonary elasticity has recovered. This type of bronchiectasis is also readily diagnosed by radiography.

## CHAPTER III

## BRONCHOPNEUMONIC PHTHISIS

*(Bronchopneumonia Tuberculosa).*

BRONCHOPNEUMONIC phthisis, or caseating bronchopneumonia, may be described under three heads, (*a*) nodular, (*b*) nodal, and (*c*) pseudolobar, according as the foci are quite small and nodular, or larger and multilobular (nodal). The latter may fuse and produce extensive tracts (pseudolobar), which then approach in appearance the pneumonic forms. For the sake of convenience this type is described in Chapter IV.

Bronchopneumonic tubercle is the classical type in children. Both in children and in adults it is *secondary* to primary foci already present within caseating hilar glands, or to infiltrations occurring in a state of softening or excavation within the lung itself. It may follow influenza, one of the infectious fevers (measles, etc.), and diabetes; it may occur in women exhausted by frequent pregnancies and by the repeated nursing of children; also it may complicate the debilitated conditions produced by penury and starvation.

1. *Disseminated nodular Phthisis.*

When fragments of a softened caseous gland, or portions of a caseating dissolving mass, lying in an apical or perihilar cavity, become detached and obtain access to the air passages in larger bulk than can be conveniently and adequately expelled *pari passu*, bacilli may be scattered by inspiratory efforts, either widely throughout both lungs (general dissemination) or may affect certain areas of one or both lungs alone (partial dissemination). This process of dispersal, which may accompany the periodic exacerbations of chronic cavitary pulmonary tubercle, and may be attended by slight hæmoptysis, increased cough and

pyrexia, plays a much greater rôle in the evolution and the radiographical topography of pulmonary phthisis than clinical examination suspects or is able to reveal. No period, not even old age, is exempt from its possible occurrence, provided the necessary lesions exist within the lung. As elucidated *by radiograms*, it appears to take place in the adult, perhaps more frequently during the third and fourth decades of life. Moreover, isolated groupings of small rounded foci, often present in the lateral areas of the chest, near the axillary lines, frequently owe their origin to a similar cause; in the process of time these may become inoffensive fibroid specks, or may vanish altogether from view. General and partial dissemination is consequently a secondary manifestation, due to the persistent and fitful activity of primary foci, situated either within caseating glands or among the debris of imperfectly evacuated cavities. Such disseminated foci appear as grayish white nodules, located, in recent cases, at the extremities of the bronchioles. They are independent of each other at first; but are crowded and packed together so as to give a granular appearance to the fluoroscopic screen and to the lobules as seen post-mortem. Primarily of the size of a grain of millet, or of a hemp seed, they may rapidly increase in size and become as large as a bean, or the nodules may aggregate to form larger opacities, producing finally either bronchopneumonic nodal or pseudolobar infiltrations (*q.v.*). Careful examination of a satisfactory radiogram will usually discover the presence of a large or of several small cavities, with surrounding infiltrations on one or both sides, about the level of the anterior osseous extremity of the first rib, within the axillary areas, or in the depth of the perihilum. These cavities may not present the aspect of old thick-walled extinct excavations, but their outlines may be less definite, irregular, and obviously they still enclose caseating material. There is often a tendency to general cylindrical dilatation of the smaller bronchi (paresis of the muscular



RAD. 17 (Ant.)—Disseminated nodular phthisis.



RAD. 18 (Ant.)—Disseminated nodular pulmonary tubercle,  
dextro-trachea.





RAD. 19 (Ant.)—Disseminated phthisis. Cavity right apex.



RAD. 20 (Ant.)—Disseminated phthisis. Pleuritic effusion left base.



wall); in some areas the foci are arranged around the circular bronchial transparencies; in others they stud the bronchial walls, fortuitously cut in their long axes, and these foci may coalesce to form fibrocaseous, ultimately fibroid sheaths.

The severity of the process varies within the widest limits. Occasionally the condition may remain, in older patients generally, for months *in statu quo*, and a second radiogram may reveal minor changes only; in others, where the bronchi appear little affected, and no fibrosis succeeds, the process of aggregation and infiltration advances rapidly, leading to extensive confluent pseudo-lobar infiltrations, and a fatal issue within a few months. Even in the widely disseminated cases the *physical signs* may be indefinite. The percussion note may be slightly, if at all, impaired, or there may be an emphysematous note (general dilatation of small bronchi?) and an absence of retraction of the chest. Auscultation may reveal a few doubtful crepitations, perhaps at one apex or base, or within the lateral axillary lines, and occasional sibilant sounds. Hæmoptysis is rarely profuse; it may be a mere staining or it may be absent altogether. Cough may be persistent, expectoration trifling, pyrexia irregular but not severe, and night sweats may cease. The expectoration may contain bacilli, intermittently in accordance with the repeated exacerbations. Emaciation in some instances is pronounced. Very occasionally a local pleuritic effusion, perhaps basal and axillary, may be present.

CASE I.—Walter R—, æt. 44 (2.7.18). *Clinical*: pain in side and cough for ten weeks: wasting +: hæmoptysis +: began in pleurisy three months ago: now unable to follow his employment: right apex in front and behind slight impairment of percussion note: crepitations right apex: in left lung crepitations in mammary region: dulness at bases behind. *Clinical diagnosis*: phthisis and pleurisy. *Radiogram 17*: disseminated tubercle showing patchy aggregations: enlarged hila: cavities at

right apex (only visible on the plate): slight emphysema of both lungs and general cylindrical dilatation of the bronchi.

CASE 2.—George H——, æt. 21 (9.4.18). *Clinical*: cough and hæmoptysis: emaciation, 1 stone: dyspnœa + +: heart apex beat normal: movement diminished and slight flattening at the right apex: crepitations both apices. *Clinical diagnosis*: pulmonary phthisis—both apices. *Radiogram* 18: shows a general dissemination of foci throughout both lungs: small excavations in the right supraclavicular apex: irregularly located aggregations of foci in the right lung: an extensive bronchopneumonic infiltration in the left lung: enlarged paratracheal glands on each side of the central mediastinal opacity.

CASE 3.—William G. B——, æt. 21 (9.4.18). *Clinical*: cough +: hæmoptysis—: emaciation, 2 stone: night sweats—: movement diminished and flattening of right chest: crepitations at both apices. *Clinical diagnosis*: double apical phthisis. *Radiogram* 19, contraction left chest, large cavity right apex with a central more translucent area (bronchus?): both lungs filled with small nodular foci apparently becoming arrested on right, rather sparing dispersal of foci throughout left lung: both hilar opacities increased in area and density: nodal opacities in left hilum: some emphysema of right lung.

CASE 4.—William V——, æt. 28. *Clinical*: t° 97°–98°: Tbc. +: signs of infiltration at the right apex and of fluid at the left base (where breath sounds, vocal fremitus and vocal resonance are absent). *Radiogram* 20: general disseminated foci throughout both lungs: just beneath the middle of right clavicle an infiltration containing less opaque areas (cavities): some of the foci in right lung becoming calcareous or fibroid: left basal effusion, not reaching as high as the nipple (metal square): very slight deviation of heart towards the right side. The case affords one of the numerous illustrations of the contrast between the poverty of clinical and radioscopical and the wealth of radiographical signs. With the fluorescent screen the opacity at the right apex and



R.A.D. 21 (Ant.)—Disseminated fibroid phthisis, chiefly left lung.



R.A.D. 22 (Ant.)—Disseminated fibroid tubercle with cavities.  
Microcardia left lateral.



the small basal effusion on the left side alone were visible thus demonstrating the absolute unreliability of radioscopy *per se*, except in gross lesions.

In the chronic or subacute cases, the fibrosis becomes more pronounced, and the dissemination, if primarily more or less general, becomes restricted to localised areas.

CASE 5.—Frederick B——, æt. 60, painter. *Clinical*: hæmoptysis frequent and small in amount: cough +: temperature 97°–98°: Tbc. +: clinical signs chiefly of emphysema and bronchitis. *Radiogram 21*: small cavities within the left supraclavicular, and apparently two larger in the infraclavicular areas: disseminated small foci in the lateral part of the left lung: calcified rib cartilages.

CASE 6.—Leonard S——, æt. 23: ex-soldier. *Clinical*: percussion note impaired at both apices: weak breath sounds left apex: crepitations in right lung: no pyrexia: Tbc. +: *Clinical diagnosis*: pulmonary tuberculosis of both lungs. *Radiogram 22*, a large cavity cut by clavicle on right side: in left supraclavicular apex and upper subclavicular triangle several lighter areas: fusiform fibroid bands of opacity running towards left hilum: a cavity (pseudo?) between second and third ribs at the left axillary border: disseminated foci in the right middle lobe and in the axillary region of the left lung. *Radiological diagnosis*: chronic fibroid disseminated phthisis.

### *Disseminated Nodal Phthisis.*

In some cases the nodal foci may be numerous, closely packed together (*Radiogram 23*), and the disease is subacute. One sees this form occasionally in middle-aged men addicted to alcohol; when well defined, it may be termed the inebriate's lung. In others the nodal infiltrations are few, the progress is slow and may become actually arrested.\* Chronic apical and perihilar infiltrative

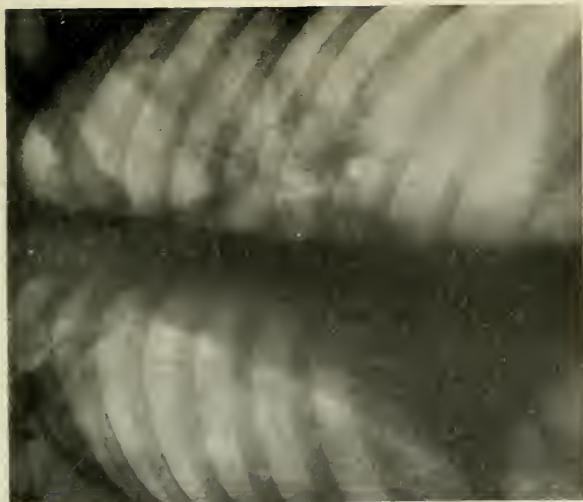
\* These nodal infiltrations, when radiographed later, often pass *directly* into healed patches of fibrosis. This transformation is dependent upon the nature of individual resistance, which may be *inherent* or *acquired*.

types are described in Chapter VI. The subacute and chronic dissemination from the primary caseous focus may be partial only, or advance may be made by mere contiguity, that is, by the passage of bacillary sputum along the walls of the bronchi: or by way of the lymphatics. In the acute types aspiration probably plays a more important rôle by carrying the bacilli to distant parts of the lungs. If the general dissemination occurs at a time when the systemic resistance is low, the foci may rapidly enlarge and produce pseudolobar infiltrations, which appear as extensive opaque areas on the radioscopic screen, producing an acute phthisis of short duration.

In bronchopneumonic nodal types the cough may be frequent, it may be accompanied by a greyish-white expectoration, and the dyspnœa may become far more severe than is warranted by the meagre physical signs. There may be small scattered areas, in some cases, of sibilant or subcrepitant râles; in others, localised regions of bronchial breathing and bronchophony, not necessarily more pronounced towards the apices: loss of weight and strength, and obvious cyanosis. The diagnosis rests on the examination of the sputum, and on the radiogram. In some instances, where prolonged pyrexia occurs in cases of creeping or wandering influenzal bronchopneumonia, where cough is slight and expectoration is trivial or unobtainable, but loss of strength and emaciation are paramount, it is only when cavitation occurs, and this may be delayed, or when caseating foci are found post-mortem in the bronchial glands or elsewhere, that a diagnosis of tubercle becomes justified. In protracted cases of delayed resolution, after bronchopneumonia lasting several weeks, even two or three months, the radiogram will show unresolved and resolved patches of bronchopneumonia side by side in one lung, or resolved areas in one, and unresolved areas in the other lung. There may, however, be signs of old apical tubercle, and the family history may be suggestive.



RAD. 23 (Ant.)—Disseminated nodal pulmonary tubercle.



RAD. 24 (Post.)—Migratory bronchopneumonia. Crane's co  
on right.



Isaac L—, aet. 59, complains of pains in the left chest, with cough which has lasted for three months, and of emaciation. *Clinical diagnosis*: emphysema, bronchial catarrh, arterio-sclerosis. On account of difficulty in swallowing, patient was sent to the X-ray department for examination of the œsophagus by means of the bismuth bolus. This showed spasmodic contraction at the level of bifurcation of the trachea, and again lower down near the diaphragmatic opening (tuberculous laryngitis?). On account of suspicious fluoroscopic appearances, observed during the progress of deglutition, a radiogram of the chest was taken, in which (Radiogram 23) there is an irregular cavitation at each apex, and nodal consolidations are present in the upper lobe of the right, and scattered throughout the whole of the left lung, producing a characteristic dappled appearance.

For comparison the following case of influenza-pneumonia is included:—

Eliza S—, aet. 23, had a severe attack of influenza-pneumonia, commencing nine weeks ago. There is a family history of phthisis, and one sister is now in a sanatorium. The pyrexia is still oscillatory, reaching  $101^{\circ}$  or  $102^{\circ}$  of an evening, with morning remissions: emaciation is severe, but cough and sputum are absent. It was suggested that an encysted empyema might be present, but the clinical signs and the radiogram negative this possibility. The latter (Radiogram 24, posterior) reveals a bronchopneumonic irregular consolidation affecting chiefly the area around the interlobe, and showing transparencies due to dilated tubes, Crane's inverted comma along the right side of the trachea, and partial resolution of the left basal bronchopneumonia, which was present three weeks ago in the first radiogram. There may have been an apical bronchopneumonia as well on the left side, as shown by the small excavations, and a slight opacity above the left clavicle. On the other hand, the lesion at the left apex may be tuberculous: if this is the case the prognosis becomes unfavourable. The left diaphragm was immobile. Pyrexia gradually abated and strength returned slowly for a

time. Subsequently an encysted empyema was found radiologically, which was treated by resection and drainage. The patient is still under treatment (22.7.19).\*

† An example of chronic localised nodal disease is shown by Hilda A——, aet. 27 (Radiogram 25): she has suffered from cough for a month, with small hæmoptyses on several occasions: wasting + : physical signs indefinite. The radiogram shows several bronchopneumonic nodal opacities, in the right supraclavicular apex, over the first right rib, and in the first right anterior interspace, also several in the base of the right upper lobe, a few in the left upper lobe, and a condition of diffuse cylindrical bronchiectasia, especially in the right lung. There are indistinct signs of a cavity below the middle of the right clavicle. Clinical examination is inconclusive: there is no sputum and the physical signs are ambiguous.

They are generally considered to be cases of chronic bronchitis on account of the presence of rhonchi and *rubber ball sounds* in certain areas, may be the apex, the axilla, or the mammary region; but the real diagnosis is evidently chronic nodal pulmonary tubercle.

\* Two months later the patient died. No examination was allowed.





RAD. 25 (Ant.)—Chronic nodal tubercle.



RAD. 26 (Post.)—Galloping phthisis.

## CHAPTER IV

## BRONCHOPNEUMONIC PSEUDOLOBAR TUBERCULOSIS (APICAL)

APICAL bronchopneumonic phthisis may be acute, sub-acute, or chronic. In the very chronic forms the area of apex infiltrated is generally small, and situated usually at the level of the anterior osseous extremity of the first rib. Here a fibrocaseous patch may be found, with small irregular cavitation within it, or a definite isolated cavity. When the disease spreads downwards it may heal from above, and exhibit a slowly advancing margin of consolidation in the lower part of the upper, or within the middle lobe. In some cases the initial focus may be in the axillary region.

In the more acute apical and perihilar forms, symptoms such as cough, pyrexia, emaciation, and anorexia are often prominent before the diagnostic signs appear. Such signs as diminished or weak breath sounds, diminished supra-clavicular isthmus, granular breathing, harsh breathing with prolonged expiration, interrupted breathing, are not pathognomic, since they may be merely the persistent signs of an arrested tuberculosis.

In the ordinary apical phthisis, Fowler localises the initial lesion about two inches below the right apex, and nearer the posterior surface of the lung. Chauvet places this primary focus in the middle of the line joining the intervertebral space between the seventh cervical and first dorsal with the tubercle of the spine of the scapula (which is generally quite easily seen and felt). This corresponds with the radiographic appearances, consequently early cases are most profitably auscultated and radiographed in the supraspinous fossa about the level of the third dorsal spine. Before the complete invasion of the upper lobe is accomplished, a second lesion may appear below the apex of the right lower lobe at the level of the fifth spine, and

about half way between it and the inner border of the shoulder blade. It is said that an interval of quiescence may now take place, after which the lesion commences to spread in two directions, (1) along the right interlobe, (2) towards the right base; and a third lesion appears in the upper lobe of the opposite lung. To follow the line of march radiographically it is necessary to take stereoradiograms at frequent intervals in typical cases; and the results do not entirely coincide with those deduced from percussion and stethoscopy. In many cases the disease starts almost simultaneously in both apices; in others the left apex only is attacked, and the disease may then remain for a long time unilateral; occasionally it seems to spread downwards on the right (apical), and centrifugally from the hilum on the left (perihilar). Furthermore, when cavitation occurs in both acute and chronic cases, the line of march may be obscured by the occurrence of showers of bronchogenic foci affecting both lungs, and may subsequently advance more quickly in certain unexpected situations.

1. Sidney S——, æt. 16 (4.2.19): had an attack of influenza, July, 1918: cough + : emaciation + : night sweats + : hectic +. *Clinical signs*: crepitations both apices, particularly on the right. *Radiogram*, posterior (No. 26): bronchopneumonic pseudolobar tubercle spreading from right apex, with cavitation below the clavicle, and a second beneath the axilla; consolidation in the middle lobe: and deposition in the right basal lobe: on the left, cavitation commencing below sternal end of left clavicle, and slight areas of infiltration in the apex of the lower lobe of left lung (*galloping phthisis*).

2. Emma B——, æt. 18 (12.8.18): suffered from pleurisy, Christmas, 1917. *Clinical*: movement of left chest deficient: no crepitations: winter cough: wasting: night sweats: anæmia. *Radioscope*: left diaphragm, *inner half only* mobile: heart apex not adherent: large opacity in middle of left field. *Radiogram* No. 27A (anterior) shows an advanced bronchopneumonic phthisis, apparently commencing at right apex, where indurations and a number of small cavities are visible. It has spread

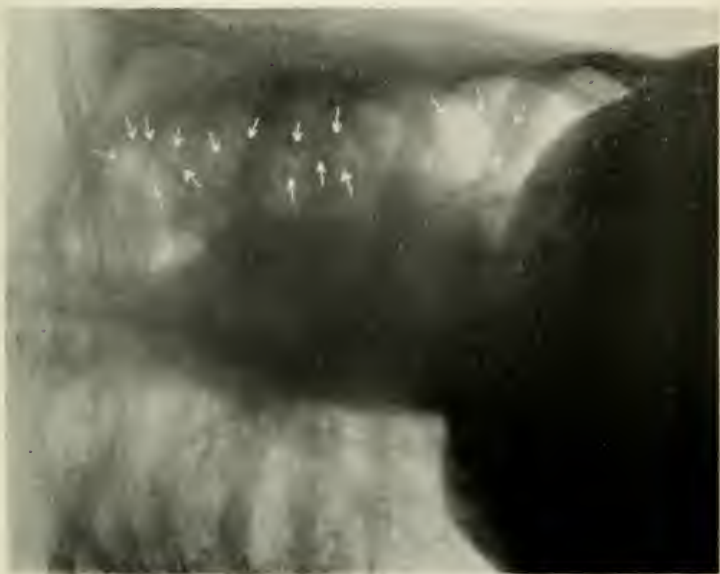


RAD. 27A (Ant.)—Bronchopneumonic pseudolobar phthisis, left.



RAD. 27B (Ant.)—Chronic fibrocascous phthisis.





RAD. 28 (Ant.)—Perihilar bronchopneumonic phthisis.



RAD. 29 (Ant.)—Perihilar pseudolobar phthisis.



throughout the right lung : subsequently it has settled in the left hilar area, thence spreading outwards into the left lung. The latter is riddled with small cavities as far as the supraclavicular apex. Some of the opacities in the right lung are very opaque, and probably calcareous. At present the disease appears to be quiescent (bronchopneumonic pseudolobar).

3. Alice B——, æt. 24 (at least seven years in duration), was in sanatorium in 1912 : complains now of frequent cough : expectoration is scanty and white : weight 10.10 in sanatorium, now 8.6 : was diagnosed in 1912 double apical phthisis. *Clinical signs* : crepitations at the left apex and rhonchi in left upper lobe : no enlarged cervical glands (Radiogram No. 27B). It is difficult now to realise the line of march : there are sinuous small excavations at right apex in the second anterior interspace : some thickened tubes in the middle lobe : both hilar regions are cloudy : on left side dilatations of tubes : sinuous cavitation : a pleural apical cap, and a few small transparencies in the left supraclavicular apex : bands of indurated fibrosis along the bronchi : heart central, some dilatation of the right auricle.

*Perihilar Bronchopneumonic Pseudolobar Phthisis*  
(*Subacute and Chronic*).

It has been already stated that perihilar disease, whether uni- or bilateral, may be secondary to an apical lesion ; very often, however, both apices, so far as clinical and radiological examination can determine, are normal. Five examples of this type are now described :—

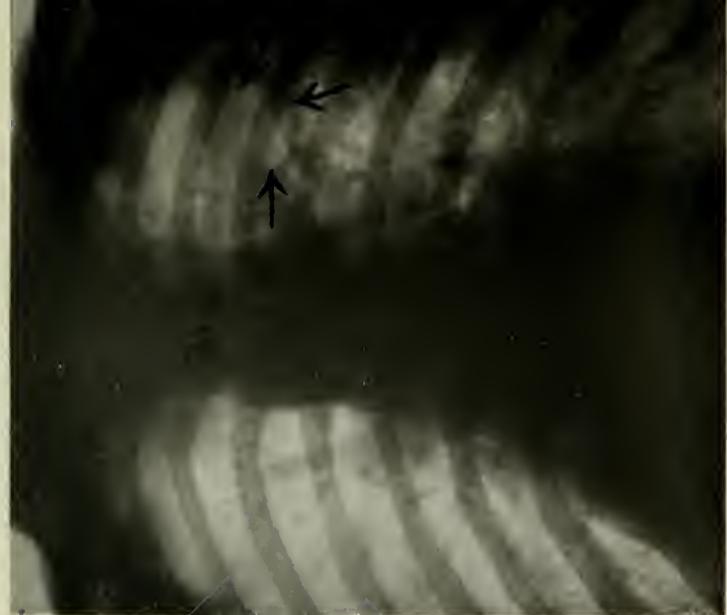
1. Amelia R——, æt. 35. *Clinical* : in the right upper lobe percussion note impaired, a few crepitations. In the left upper lobe expansion diminished : there is tubular breathing above, becoming amphoric near the nipple : cardiac apex not found. *Radiogram 28* : on the left side there are many rounded opacities (bronchopneumonic nodal), connected by less dense indurations : an irregular cavitation extends as far as the supraclavicular apex. On the right side a narrow band of disconnected induration from the hilum running outwards towards the axilla, and containing small cavities.

and dilated tubes: the right phrenic leaflet is much higher than the left. There are a few opacities in the right middle lobe. The disease on the right is older and becoming arrested. The right extreme apex is free. This patient contracted influenza during the winter of 1918, with a fatal result.

2. Regina R——, æt. 16. *Clinical*: has suffered from cough for 18 months: expectoration + : tubercle bacilli + : right lung, percussion note impaired: crepitations right apex: harsh breath sounds behind with increased whisper: temperature, 96°–98°. *Radiogram 29*: a unilateral bronchopneumonic pseudolobar infiltration, spreading along the right interlobe with irregular excavation (arrows) above and below it, near the hilum. The lesion extends along the bronchi to the supraclavicular apex, where excavation also has ensued. The left lung is practically free. The heart, aorta, and trachea deviated slightly towards the right.

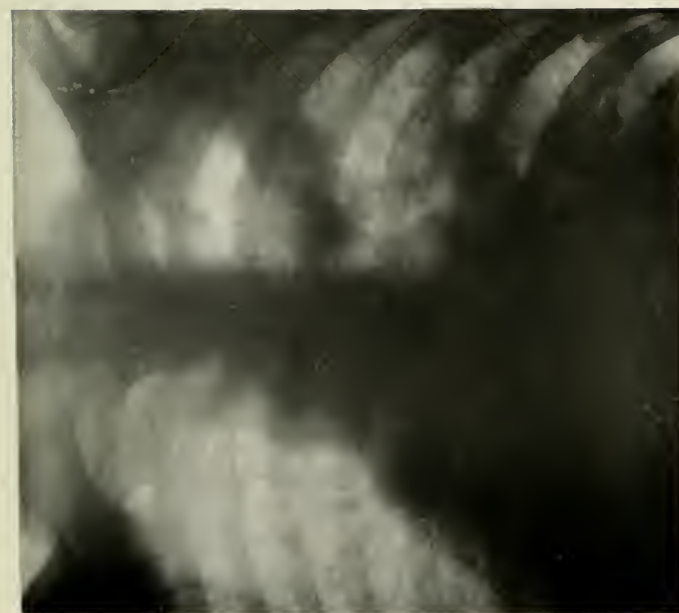
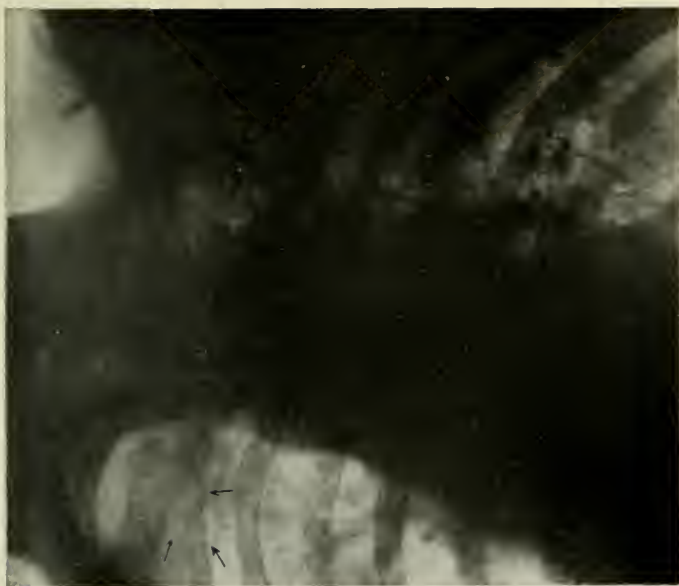
3. James S——, æt. 26: family history +: cough +: expectoration +: hæmoptysis small, on several occasions: night sweats —: 97·6°–99·6°: Tbc. after several examinations —. *Physical signs*: indefinite: a few doubtful crepitations observed on two occasions between vertebral border of scapula above the spine and the vertebral column. Classed B, June, 1917. *Radiogram 30A* shows several round bronchopneumonic foci, nodal, outside the right hilum in the interlobar region, with some surrounding induration and thickened tubes or congested vessels running fan-wise towards the axilla. *Radiological diagnosis*: right interlobar phthisis. Ten months subsequently re-examined. *Clinical*: cough +: Tbc. now +: emaciation +: night sweats +: has had an *attack of pleurisy* on right side. *Radiogram 30B*: there is now a single perihilar cavity (arrows) in the right interlobar region, which is "silent" to the stethoscope and communicates with several bronchi: dilated tubes in the middle lobe surrounded by bands of infiltration apparently becoming fibroid: diminished interspaces on the right, and enlargement of right paratracheal glands. A thin infiltration towards the right base.

4. Robert C——, æt. 40 (10.9.17). *Clinical*: patient had an attack of rheumatoid arthritis four years ago:



RADS. 30A and 30B (Post.)—Perihilar nodal tubercle, with subsequent cavitation (interlobar).





RADS, 31A and 31B (Post.)—Perihilar interlobar tubercle, becoming disseminated later.





RAD. 32 (Ant.) Perihilar nodal tubercle in places pseudolobar.  
Right basal pneumothorax.



now complains of morning cough, with slight expectoration: a small hæmoptysis occurred for the first time four days ago: a few scattered catarrhal sounds in the right lung, but there are *no definite physical signs*. *Radiogram 31A*, posterior, shows a band of infiltration containing small cavities in the right interlobar area: involvement of the middle lobe: *lateral scoliosis*, convex to the right. *Diagnosis*: right interlobar phthisis. *Second examination* (12.3.18). *Clinical*: crepitations (?) both apices (crackles), distant tubular breathing over right middle lobe: weight slightly increasing. *Radiogram 31B*. There has been a dissemination from the interlobar cavities, which foci now appear to be undergoing fibroid metamorphosis. The disease has now become unilateral *disseminated fibroid*. The old excavation at left apex is visible. The patient is now following his employment. Scoliosis appears to be frequent in these unilateral forms.

5. Alice W.—, æt 20. *Clinical*: anæmic: cough for six weeks: expectoration scanty: hæmoptysis—: emaciation (?): night sweats+: dyspnœa+. The chest is long, emphysematous: crepitations (?) at apex: catarrhal sounds behind: supraclavicular isthmus on each side equal ( $4\frac{1}{2}$ ): *Radiogram 32* shows a left perihilar tuberculosis extending to the summit of upper lobe: some left hilar and perihilar excavation: right basal tubercle: two large calcareous opacities (arrows) in right lung, and a small basal pneumothorax (arrows). Partial pneumothorax as visualised by radiology in quiet tubercle often occurs *in connection with a subpleural calcareous focus*, and it is generally free from fluid. The condition in the upper left reminds one of the Laennec's grey infiltration, which is really a caseating lobular chronic bronchopneumonia.

*General Remarks*.—The above illustrations show that perihilar fibrocaceous tubercle may be almost exclusively unilateral. If bilateral the pulmonary lesions are not, as a rule, cotemporaneous; one may be subacutely progressive, whilst the other is manifestly quiescent, even retrogressive. They arise in connection with hilar or perihilar glands on the same side, and may produce either discrete discon-

nected nodes or broad homogeneous infiltrations. At times the disease may arise from apical lesions—presumably, from their radiological aspect, semi-quiescent—in the same or in the opposite lung, when bacilliferous material, issuing from a cavity, is scattered broadcast throughout the bronchi and fastens upon the perihilar area. During its subsequent evolution, cavities may form in the perihilum, and a second dispersal of aerial foci may proceed from them which may be partial—affecting the diseased side only—or it may be general. In Radiogram 30A the interlobar dissemination is discrete, and probably has spread by way of the lymphatic tracts. The evacuation of the deep perihilar cavity (Radiogram 30B) is not yet complete; but, in this case, there has been up to the present little deposition of foci in adjacent parts of the lung.

The disease advances in the upper lobe towards the axilla; in the lower lobe towards the costophrenic sulcus, finally, in each case, producing a cuneate tract of infiltration with its apex situated at the hilum. In the left upper lobe, on account of the absence of the superior fissure, the opacity may be fan-shaped (Radiogram 28). As the lesion marches centrifugally it becomes more and more superficial, until in certain areas the characteristic tuberculous *r*âle becomes audible to the stethoscope. In the earlier stages, when symptoms form the chief clinical feature, post-tussive inspiratory crepitations may be detected (*a*) *at the sides* of the chest, between the axillary lines above the level of the nipple; (*b*) *in front*, on the left side in particular, in the parasternal area within the second and third interspaces, or (*c*) *behind*, at the level of the hila or a little higher, between the vertebral border of the scapula and the spine, also (*d*) *along the interlobe* on the right, or (*e*) *at the base of the lung*. Mistakes may be made by the clinician, who thinks only of apical crepitations, and does not auscultate the fissures, the axilla, and the base. When the disease progresses towards the summit, crepi-

tations (œdema ?) are occasionally conducted towards the apex, before any radiological evidence is forthcoming as to the existence of disease in that area. Pleuritic pains in the axillary regions, and right basal effusion, are not infrequent. The latter is more likely to occur when the middle and lower lobes are invaded. Basal effusions may be met with in middle age, which recur several times after tapping, and may conceal perihilar discrete foci in the middle and lower lobes. At this period of life they may be accompanied by serious cardiac embarrassment and alarming dyspnoea, which necessitate a partial evacuation of the fluid.

Perihilar bronchopneumonic infiltration, when bilateral, may therefore occupy the wings of the chest, or it may approach the apex in the one, and the base in the other lung; there may be an obvious protrusion of the middle intermammary region of the chest, especially in women, and the more marked the deformity the more likely is the disease to be semiquiescent or arrested. Such disfigurement may be termed *annular emphysema*. There is a greater tendency in this type to fibrosis and chronicity than in the purely apical variety. The prognosis is more serious in the cavitary forms, and, *cæteris paribus*, the younger the age of the patient; when the foci are small and disconnected, the prospect is brighter than when continuous tracts of infiltration are visible on the radiogram. In the strictly unilateral forms the outlook is also more favourable. Finally, this essentially chronic type appears to be more closely connected with the flat chest (*thorax aplati*, or *paralyticus*), whether congenital or acquired, which, when it becomes emphysematous, still remains practically flat, merely bulging, if at all, in the lower middle and basal parts of the lung.

Perihilar, attenuated or abortive tubercle (*phthisis minor*), and perihilar fibroid are mentioned later (Chapters V and VI).

## CHAPTER V

## CHRONIC ATTENUATED OR MINOR PHTHISIS

To the radiologist a heterogeneous multiplicity of forms is included in this category. The disease is generally strictly localised; it may become temporarily arrested, or may possess a certain low activity which is more or less continuous. It may remain quiescent for many years, occasionally altogether; and then approach the type described by Bard under the title *Abortive Phthisis*. The latter embraces cases where post-mortem examination reveals a few apical scars containing caseous, calcareous, or fibrous nodules. These nodules may also occur beneath the pleura in other parts of the lung, or within its deeper regions. At other times an area of fibro-pneumonic infiltration is discovered, in the interior of which there may be several calcareous foci, a dilated bronchial tube, or one or more smooth cavities. The mediastinal lymphatic glands may be enlarged, and fibroid or calcareous. The physical signs are indefinite; there may be an impaired note at the apices, increased vocal vibration, harsh inspiration, prolonged expiration, weak breath sounds, and slight bronchophony, without crepitations. The symptoms are equally inconclusive; pyrexia is absent or trivial, there is an occasional dry cough, absence of bacilli in the sputum, and non-bacillary hæmoptyses (due to congested arterioles?). During the period of hæmoptysis areas of small crepitant râles, and of slight tubular breathing, may be perceived along the fissures, and occasionally concomitant signs of pure mitral stenosis, chlorosis, or thyroidean hypertrophy, may be present. According to Piéry, the so-called *latent* forms, which give no clinical signs, and have no appreciable effect on the organism at large, are more or less permanently arrested, and are often due to affections involving the tracheo-





RAD. 33 (Ant.)—Apical nodular tubercle. Cavity right apex.



RAD. 34 (Post.)—Apical infiltration, left apex.

bronchial, bifurcation, and hilar glands, as well as those of certain extra-thoracic regions (axillary, cervical, mesenteric). The quiescence may be interrupted by the occurrence of a hæmoptysis, or of a pleurisy with or without an effusion. These patients may therefore exhibit periods of low-grade activity, in which there may be slight evening pyrexia and moderate night sweating, anæmia, loss of weight, fatigue, headache, and lassitude.

The disadvantage of Bard's classification lies in the fact that it was made before the advent of reliable radiography, and, as a consequence, it is to some extent one-sided, unsatisfactory, and incomplete. This authority, moreover, is apt to draw broad distinctions where radiography demonstrates obvious connecting links. Clinical examination is notoriously unable to decipher correctly, if at all, events occurring far beneath the surface, whilst it is practically mute with regard to hilar and perihilar lesions. In the absence of actual post-mortem investigation, which in most of these cases is obviously unattainable, the rays constitute its most reliable substitute; experience diminishes year by year the objections and hostile criticisms directed against it, and at the same time emphasises its value and its necessity.

*The radiographical manifestations* exhibited by the mass of minor pulmonary phthisis may be arranged in the following manner: (*a*) apical nodular, (*b*) apical infiltrative, (*c*) perihilar discrete and disseminated, (*d*) perihilar infiltrative, (*e*) perihilar fibrotic, (*f*) lymphatic disseminated, and (*g*) bronchitic. Examples of each will now be described.

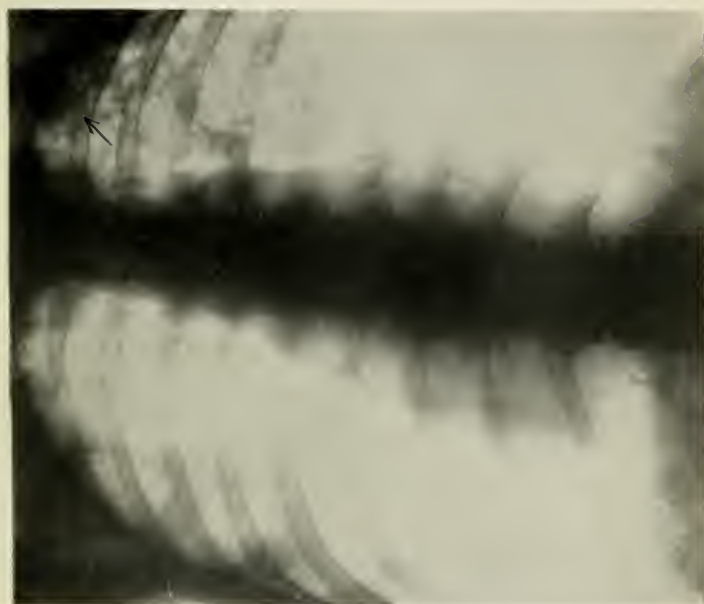
As a general rule these cases are *closed*, that is, the sputum, if obtainable, is devoid of bacilli. The symptoms are slight, and, except at certain times, may cause little or no anxiety—malaise, slight loss of weight, tachycardia, occasional night sweats. There may be a few indefinite crepitations either at one apex, within the axillary lines, along the interlobes, or at the base.

(a) *Apical nodular*. George F——, æt. 45 (8.5.19) : dull to percussion at right base : weak breath sounds : TF —: VR —: *Diagnosis*: thickened pleura + phthisis of the right lung : had influenza with pneumonia in December, 1918: cough since : does not improve : invalided from Army, March, 1919, with the diagnosis of chronic bronchitis and emphysema. *Radiogram* 33, nodular tubercle, affecting right apex especially : excavation right supraclavicular apex near axilla : calcareous opacities, one large opacity at the level of left clavicle near sternum: dilated tubes left upper lobes : emphysema both lungs : slight hypertrophy of left ventricle. A chronic case, reactivated probably by influenzal attack.

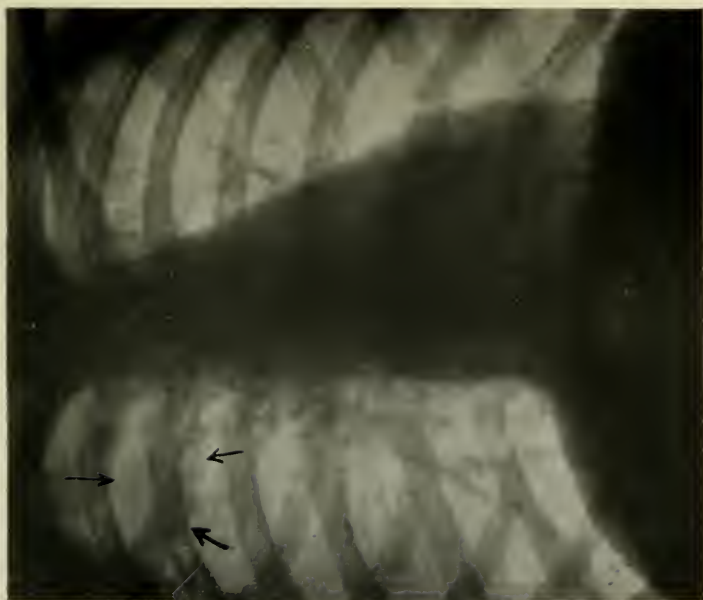
(b) *Apical infiltrative*. Elizabeth L——, æt. 38 (3.3.17): was in hospital for gastric ulcer in 1916: suffered from an attack of pleurisy two months ago with cough and hæmoptysis (§IV) at commencement. Right apex, percussion note impaired, air entry at both apices poor, a few crepitations at the left apex: Tbc —. *Radioscope*: diaphragmatic movements good: both supraclavicular apices open on cough: pulmonary transparency generally impaired. *Radiogram* 34, posterior, an area of infiltration at left apex, containing small cavities: in right axilla an opacity suggesting a fibroid patch, to which a thickened bronchus runs: a few scattered old foci in right lung: emphysema in right base: interspaces diminished above on right side: mediastinum slightly deflected towards left: slight scoliosis, convex to right. (In scoliosis the interspaces on concave side are narrower.) Evidently an old non-progressive case. (A very common type of minor phthisis, but generally the right apex is involved instead of left.)

3. Emma R——, æt. 39: had pleurisy on left side two months ago with pain: cough + : yellow expectoration: no hæmoptysis: general weakness. *Clinical*: moist sounds, emphysema: *diagnosis*, chronic bronchitis. *Radiogram*, posterior, 35: below apex of right axilla, an area of induration, a few cavities with disseminated foci within right upper lobe, especially between axilla and hilum: emphysema: median heart, cardiopneumosis.

4. Ellen M——, æt. 25 (5.3.19): influenza pneumonia last November: cough —: expectoration —: hæmopt-

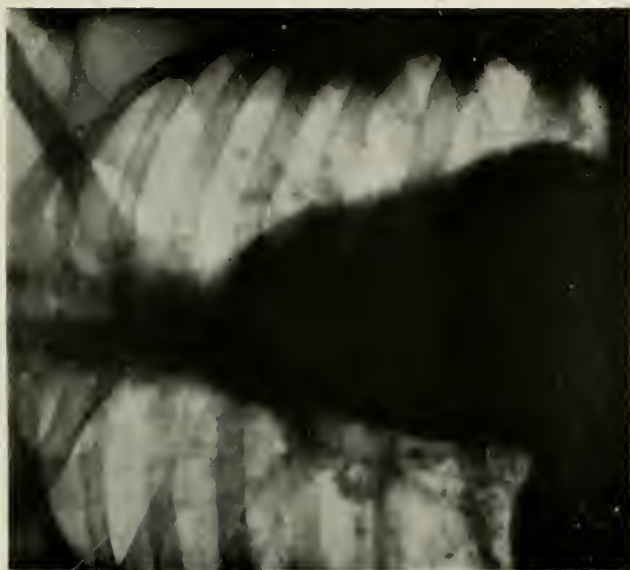


RAD. 35 (Post.) Axillary infiltrative phthisis. Cavities,  
cor pendulum.



RAD. 36 (Ant.) --Tuberculous infiltration, right apex.





RAD. 37 (Ant.)—Mitral stenosis. Perihilar tubercle.



RAD. 38 (Ant.)—Double perihilar tubercle. Thorax paralyticus.



tysis — : emaciation — : dyspnœa + : pain occasionally on left side. Right apex a few moist sounds, and percussion note impaired: t° irregular, 97°-99° : *Radiogram* 36 : slight deviation of mediastinum to left : patch of infiltration in right axilla with a few small cavities : thickened tubes and bands of cirrhosis in both fields, especially at the right base and in the middle lobe. Many sanatorium cases exhibit a similar appearance. Occasionally the infiltration is in the left upper lobe instead of the right.

*Perihilar discrete.*—Annie C—— (19.3.18), æt. 24 : an in-patient six years ago : remained well till January, when she began to be hoarse (paralysis of left cord) : glands of neck on left side enlarged, but not caseating : doubtful signs at both apices : mitral stenosis. *Radiogram* 37 : enlarged left auricle (mitral stenosis) : old caseating nodal foci (some calcareous) in both lungs, especially right middle lobe : left paratracheal glands not obviously enlarged : paralysis of cord probably due to enlarged left auricle compressing the recurrent nerve against aorta (case of minor tubercle associated with mitral stenosis).

Nellie K——, æt. 32 : husband suffers from pulmonary phthisis, he has been in a sanatorium and is now at home. She has complained of pain in the chest for five months : cough + : expectoration slight : hæmoptysis four months ago : wasting + : night sweats — : Tbc. —. *Clinical signs* : impaired resonance left apex, no adventitious sounds. *Radiogram* 38 : thorax pareticus, increased area of both hilar opacities : disseminated foci chiefly in lower and basal fields of lung : slight general cylindrical dilatation of bronchi : small excavations (?) in both supraclavicular apices, from which possibly showers of bacilli may have escaped with the hæmoptysis four months ago : disease now becoming quiescent. Patient seen a year later, practically *in statu quo*.

In the *flat* or *paralytic thorax* (*vide* Diag. 6) the antero-posterior diameter of the chest is reduced; the upper anterior interspaces appear broader in front than usual; the lower ribs are deep, crowded, the lowest approximating the iliac crest. There are often deep clavicular grooves and wasted pectoral muscles. The descent of the clavicle

brings the aortic bulge nearer to it. In many instances it is a secondary manifestation, the outward sign of an arrested tuberculous infection, in individuals with feeble inspiratory energy and of an acquired immunisation. Should tubercle become active again in adult life, it is generally of a slow evolutionary type, liable to become chronic, or entirely latent.

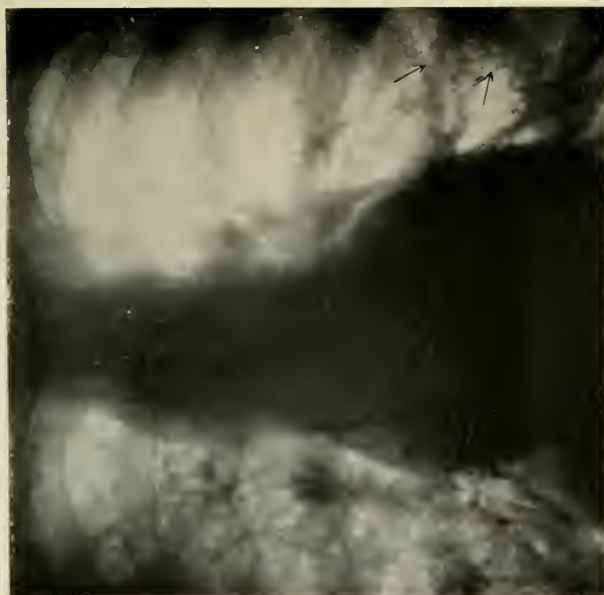
DIAGRAM 6.



Maud W——, æt. 20 (18.3.19): cough since "flu" in October, 1918: pain on left side: wasting+: sweats —:  $t^{\circ} 97.2^{\circ}$ : Tbc+: nasal obstruction: percussion note diminished on left: crepitations at bases behind: increased whisper both apices, vocal cords slightly injected. *Radiogram 39*: disseminated nodular phthisis affecting middle lobe chiefly, and base of right upper lobe: the condition at right hilum suggests an irruption into the



RAD. 39 (Ant.)—Midlobar phthisis with emphysema.



RAD. 40 (Ant.)—Chronic fibroid phthisis, right lung and base of left lung.





RAD. 41 (Ant.) Peribilar discase, cavity right axilla.



RAD. 42 (Ant.) Right peribilar infiltration, Cascating right tracheobronchial glands, Metal square right nipple.



bronchi from caseating glands: in left hilum discrete nodules, with some dilatation of tubes running to left apex: both supraclavicular apices clear: slight parietic thorax and basal emphysema, with some left axillary pleuritic adhesion.

Albert W—, æt. 29 (28.5.18): was in sanatorium six years ago: rejected by the military tribunal one year ago: cough very little: sputum of a morning: hæmoptysis six years ago, streaks: no emaciation. *Clinical signs*: right chest flat: percussion note impaired: vocal resonance+: no definite physical signs: heart deviated to right: bases clear: *Radiogram* 40: on the right side fibroid interlacing strands up to the first rib: a fibroid mass in right hilum, thickened strands and dilated tubes running to right base: on left side slightly increased density of the hilum, small nodules in the external parts of lung, and particularly towards and including the left base (mottling). Cardiac outlines somewhat increased, aortic arch apparently transposed to the right. A case which will show periodic bursts of minor activity.

Elizabeth M—, æt. 8, always delicate: bronchitis for 18 months: now cough and pain in left side for six months: t° 99°, evening: expectoration scanty: bacilli+: night sweats—: clubbing—: family history—. *Clinical*: heart apex beat normal: right chest flat, deficient movement: dulness to percussion: crepitations: posteriorly also crepitations in both lungs, and dulness below angle of scapula: cavity (?) right axilla behind. *Clinical diagnosis*: hilar phthisis, rather advanced. *Radiogram* 41: both hilar opacities increased: trachea deviated to right, rather more than normal: an opacity outside it on right, which may be an enlarged tracheo-bronchial opacity: irregular cavitation right axilla: small foci along bronchi running from right apex to right hilum, and along the bronchi passing to the right base: right phrenic adhesion (phénomène du feston diaphragmatique-Maingot).

*Perihilar and hilar infiltration*.—Henry L—(20.6.18), æt. 6: pallor: dyspnœa: tubular breathing right base, also some at left base (conducted?), and crepitations with dulness to percussion. 22.7.18, dulness at right base, no crepitations now: no tubular breathing.

*Radiogram 42*: a triangular opacity (infiltration) with base at right hilum and apex near axillary bend of the fifth rib (therefore in middle lobe with its superior edge limited by small interlobar fissure): caseating (?) tracheo-bronchial opacity on the right: some nodules along bronchi running to right apex and a few in left hilum: Tbc. —: re-examined six months later: appearances practically *in statu quo*.

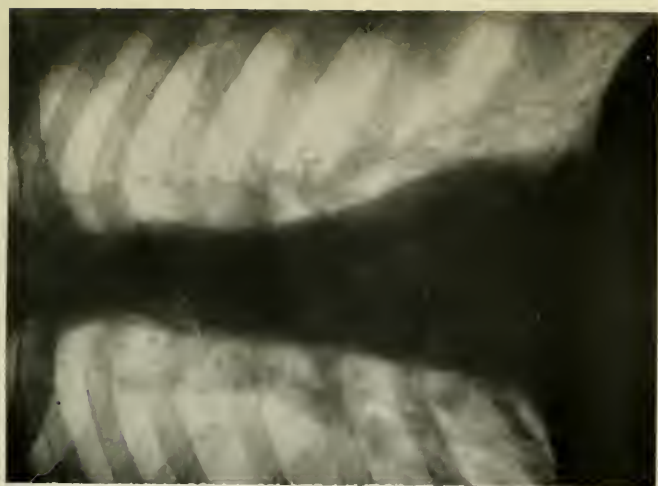
Annie M—— (3.4.19), æt. 31: suffers from bronchitis every winter: influenza, December, 1918: percussion note impaired right lung: rhonchi over left lung: crepitations left upper lobe. *Radioscope*: right diaphragm immobile, left sluggish: cuneate interlobar shadow. *Radiogram 43*: a cuneate infiltration with its apex external, starting from the right hilum: fibrosis of middle lobe: thickening of bronchi in right upper lobe, and some fibrous nodules in left hilum.

Occasionally a similar hilar infiltration is found at the base of the right upper lobe, the lower margin of which runs along the interlobe. The real significance of opacities of this kind, and in this region, is not clear. They may be due to a direct tuberculous infection of the lung by way of caseating hilar or bifurcation glands. If radiographed again at the interval of some weeks the opacity may be found to have disappeared, leaving behind merely an interlobar stripe; moreover, the opacity may reform (*recurrent hilar infiltration*). It has been suggested that these relapses may be due to the evanescent appearance of recurrent interlobar effusions. In the case of the boy mentioned above (*Radiogram 42*) it is possible that the opacity was originally bronchopneumonic, and has now, six months afterwards, become fibrotic. In other words, these opacities are not always of a tuberculous nature, and the diagnosis from bronchopneumonia must depend on subsequent radiological examination, assisted by clinical and laboratory methods of investigation.

Lily M—— (11.3.19), æt. 19: a mouth breather: nutrition good: influenza and pneumonia, October, 1918: cough +: expectoration slight: hæmoptysis in October.



RAD. 45 (Ant.) —Perihilar fibroid disseminated tubercle, chiefly  
right middle lobe.



RAD. 46 (Ant.) —Double perihilar fibrotic plithisis.



*Clinical signs*: percussion note impaired with crepitations at both apices: *Radiogram, posterior*, No. 44: both hilar opacities prominent, especially the right: two small infiltrations outside left hilum (arrows): network of thickened lymphatics (?) running to left apex: foci in the left first posterior interspace, scarcely visible except on plate: thickened bronchi or vessels in right lung: apparently an infiltration at the level of the sternal osseous extremity of first right rib: superior emphysema, some homogeneous shadowing in the basal and axillary areas on right side: a few foci brought into view through the sternal end of right clavicle.

Examples of perihilar fibrosis are described in Chapter VI. Two cases are here inserted of the disseminated type, one chiefly affecting the right middle lobe, the other both hila and their prolongations.

Ada F—, æt. 23: (T.B. Dispensary): cough nearly gone: sputum scanty: hæmoptysis—: night sweats?: emaciation?: liable to catarrh: *slight exophthalmos*: patient looks well and is not thin. Physical signs nil: *Radiogram* 45, shows a disseminated old disease, probably spreading from hilum, and producing some fibrosis of the right middle lobe: a few old fibroid specks in the lower part of right upper lobe: apices clear, excepting an apical pleural cap on left. The case may be entered among the latent forms—with regard to tubercle it is now practically quiescent. Generalised obsolete and fibroid disseminated lesions of this type frequently accompany exophthalmic goitre.

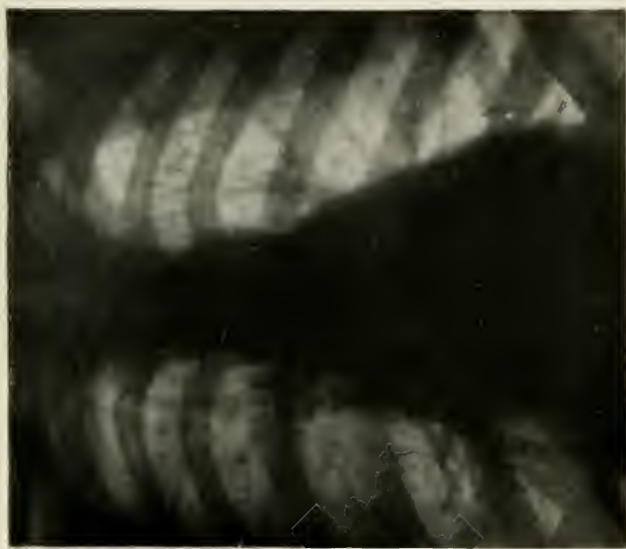
Nettie L—, æt. 22: has had a cough for two years: hæmoptysis eight months ago, small: clubbing: cough tight: vomits with cough: appetite poor: air entry into both lungs poor: at right base breath sounds practically absent: wheezy râles over both lungs: dulness to percussion over left. *Clinical diagnosis*: bronchitis. *Radiogram* 46: chest flat and paretic: basal emphysema: both hila fibrotic, prolonged upwards and downwards: bronchus running to upper left lobe dilated, and thickened: small nodules along bronchi: slight dissemination in the wings of chest: heart cardiopexy, with hypoplasia (narrow, long), aorta narrow: no infiltrations. Perihilar

fibroid disease in which the signs of past tubercle are fast disappearing.

*Lymphatic dissemination.*—Maud S——, æt. 33: suffered from severe attack of pertussis over one year ago, during which she had an attack of hæmoptysis: never well since: cough morning: expectoration small in amount and dark: palpitation: giddiness. *Clinical signs:* chest flat: weak breathing left upper lobe: slight systolic murmur: t° normal. *Radiogram 47:* linear opacities, thickened lymph trunks following the course of the bronchial tree: tubes cylindrically dilated in left upper lobe and at bases: dilated tubes in right middle lobe: commencing calcification of rib cartilages on both sides: diminished transparency in right upper lobe: right hilar shadow intense: enlargement of lymphatic nodes (at bifurcation of bronchi) nearly to the periphery: pleuritic thickening left apex.

Rosina W——, æt. 51: cough on and off since an attack of pleurisy two years ago: no expectoration: influenza nine months since: a few crepitations at right apex which disappear on cough (pleuritic): rough breath sounds on right: crepitation and friction sounds at the right base: dulness to percussion above left diaphragm. *Radioscope:* diaphragmatic movements impaired: sclerosis of aorta: some diminished transparency in the right lung. *Radiogram 48:* perihilar disseminated tubercle (peribronchial): dilatation of tubes generally with thickened walls, especially in the left upper lobe: and in certain localities, as in left mammary region, studded with small nodules. Opacities due to nipples conspicuous (arrows), both hilar opacities intense, and paravertebral bronchus in right upper lobe much thickened: several dense opacities in right hilum (anthracotic). Thorax paralyticus.

*Bronchitic(?).* Mary J. B——(5.3.18), æt. 19: in January, 1917, had an attack of influenza with pleurisy, each side in succession: in March the abdomen became distended, but subsided after a few months' treatment: cough —: expectoration —: bacilli — after many examinations: emaciation +: night sweats +: a few crepitations occasionally audible in the right upper lobe with interrupted sounds. *Radiogram (anterior) 49* shows dilated



RAD. 47 (Ant.) Lymphatic (?) follicular dissemination.



RAD. 48 (Ant.)—Disseminated quiescent tubercle.





RAD. 49 (Ant.)—Chronic fibrocascating bronchitic (?) phthisis.



and thickened bronchi throughout: dense right hilar opacities reaching nearly to the base: the bronchi and ramifications exceedingly well seen in certain localities, suggesting a perihilar caseating bronchitis: \* resembling, in the right upper lobe, the stunted branches of a leafless tree (upper arrow): a small infiltration left axilla: emphysema both lungs. (*Vide* Chapter IX.)

\* Or a slowly advancing tuberculous lymphangitis.

Additional remarks concerning the relations between tubercle and certain types of bronchitis will be found in Vol. II.

## CHAPTER VI

PULMONARY FIBROID TUBERCULOSIS  
(*Phthisis Fibrosa*)

THE designation "fibroid pulmonary tubercle" may be reserved for those cases in which the radiogram shows numerous fibroid deposits, extensive areas of fibrosis, or evidence of considerable displacement of internal organs, and deformities of the chest wall with or without the presence of cavities. In many cases the continuous shrinking of the fibrous tissue is carried to an extreme, and leads to massive distortion of the chest wall, intense crowding of the ribs, marked deviation of the mediastinum, and blurring of the aortic arch and cardiac outlines. The degree of disfigurement of the chest depends on the unilaterality of the disease, on the age of the individual, and on the production of thickened parietal adhesions of the pleural wall. The affection is often limited chiefly to one lung, the other becoming hypertrophied and passing beneath the sternum and in front of the spine into the diseased side. In these unilateral cases of pulmonary cirrhosis, whether tuberculous or purely fibroid, Bèclère has called attention to the *displacement of the mediastinum*, which occurs *during deep inspiration*, towards the diseased side.

The varieties of fibroid tubercle may be provisionally grouped in the following manner:—

1. Fibroid disseminated nodular and nodal (P. fibro-disseminata).
2. Fibroid infiltrative—pseudolobar and lobar, often containing small cavities and dilated tubes (P. fibro-densa).
3. Fibroid peribronchitic, in which the bands of cirrhosis appear either as linear, often wavy

opacities, or as shorter fusiform shadows along the course of the bronchi.

4. Fibroid diffuse granular, with a ground-glass appearance on the radiogram—chronic interstitial tubercle (P. fibro-diffusa).
5. Fibroid cavitary forms *par excellence* (P. fibro-cavernosa).

Of these types the nodular and nodal forms may become arrested for years. The ground-glass forms, which are uncommon, may be diagnosed chronic interstitial pneumonia by the clinician. These are practically permanently arrested; also the peribronchitic forms may settle down and become quiescent; in the cavitary forms, when the excavation is complete, the prognosis becomes more hopeful. The ultimate outcome is more dependent on secondary conditions, such as the incidence of sclerosis in the systemic vessels and viscera, the age of the patient, and the nature of his environment. In middle life, and beyond it, many of these cases masquerade as chronic bronchitis and asthma; the tuberculous character of the disease may only be verified by the presence of the so-called tuberculosis granules in the sputum, and its tuberculogenic power after inoculation into the lower mammals, as the guinea pig. Some more easily applied pathological test is an urgent desideratum. If incident at an early age the displacement of the mediastinal organs may become extreme; nevertheless, life may be prolonged, even under these conditions of severe cardiovascular strain, for several years (*vide* Radiograms 63A and B).

1. *Phthisis fibro-disseminata* is generally bilateral, and often appears to be the direct result of fibrosis following subacute types of the same name (Chap. III). When it is bilateral, it is usually accompanied by double emphysema, which throws into bold relief the opaque foci when viewed on the fluoroscopic screen. The picture becomes even more striking after an attack of asthma, a complication

which is frequent in these individuals as they advance in years.

(a) Archibald E——, aet. 28 (26.2.18). *Clinical*: has been in the army since boyhood: cough +: emaciation +: night sweats —: heart apex beat normal: flattening and diminished movement right apex: crepitations both apices. *Radiogram* 50: disseminated fibroid tubercle with cylindrical dilatation of tubes throughout: some cavitation at right apex: small bronchopneumonic nodes and thickened bronchi: several patches of consolidation below the left axilla, and some excavation in the lowest (arrow) *Radiological diagnosis*: fibroid disseminated tubercle.

Those cases in which the nodules become fibro-calcareous may be included in this category. They are often accompanied by calcareous metamorphosis of the lymphatic glands in the neck, in the axilla, and of the glands along the internal mammary artery. *In the unilateral forms* the diseased lung may be prevented from becoming emphysematous by the presence of thickened and adherent pleura at the base. In such cases the comparatively healthy lung hypertrophies and finally becomes emphysematous.

2. *Fibroid infiltrative disease* leads to the formation of large opaque areas, as seen on the screen. These may be present in one or both upper lobes covering the supra- and immediate infra-clavicular regions with a dense veil, or they may be present in other parts of the field, as the base of the right upper or in the middle lobe. Two cases are described in Chapter VII.

(b) Henry W——, aet. 16 (11.9.16). *Clinical*: family history —: bronchitis as a child: cough now six weeks: expectoration slight: Tbc. +: hæmoptysis —: night sweats —: movement of apices fair (?): percussion note impaired, crepitations and breath sounds harsh at both apices: pyrexia irregular: temperature normal on leaving for sanatorium (21.5.17). *Radiogram* 51: dense infiltrations at both apices, with lighter areas, on the plate at the level of the osseous end of the first right rib:



RAD. 50 (Ant.)—Fibroid disseminated tubercle, both apices.

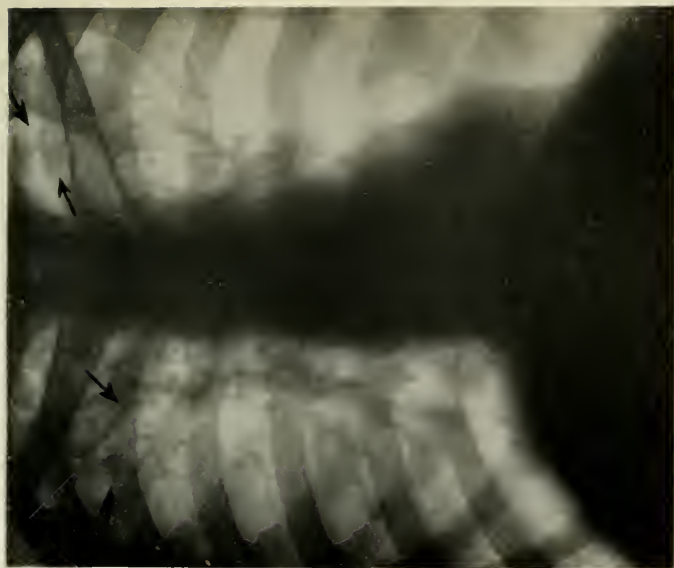


RAD. 51 (Ant.)—Fibroid infiltrative tubercle, both apices.





RAD. 52 (Ant.)—Left perihilar fibroid phthisis.



RAD. 53 (Ant.)—Peribronchitic fibroid phthisis, both apices.



disease more advanced in left upper lobe : long cirrhotic streamers running downwards along the bronchi : trachea deviated to right : some dilatation of bronchi at the right hilum, and small disseminated nodules in the rest of the right lung. Heart median, and narrow.

(c) Mrs. K——, æt. 23. *Clinical* : in left upper lobe, dulness to percussion, bronchial breathing, moist sounds : sputum, Tbc. — . *Clinical diagnosis* : pulmonary tuberculosis in left lung. *Radiogram 52* : both hilar opacities increased in density and fibrotic : scattered nodules throughout the right lung : a triangular area of fibrosis extending from the left hilum towards the axilla with its apex external, and containing a few transparencies (cavities ?). *Diagnosis*, left perihilar fibroid.

3. In the *peribronchial fibroid type* (peribronchitis fibrosa) the fibrosis often assumes the form of wavy bands of opacity, which sometimes form thick sheaths around the bronchi. They may, originally, be partial disseminated nodular ; in other instances they may be due to gradual spread along the peribronchial lymphatics from the hilum ; occasionally they are the final residues of arrested bronchopneumonic tubercle in which the lesion has advanced *per contiguitatem* along the bronchial wall.

(d) Jane F——, æt. 42 : examined as a contact case : has been nursing a daughter who died of pulmonary phthisis. *Clinical* : there are some distant sounds at both roots, especially the left, a faint cardiac systolic murmur not conducted outwards : œdema of the legs at night. *Clinical diagnosis* as regards tubercle negative. *Radiogram 53* : old cavitary infiltrations at both apices, with fibroid nodes and bands running towards the hila. Both hilar opacities dense. Dilatation of ascending aorta and slight cardiophrenic adhesion at the apex.

Such cases emphasise the advisability of the examination of contact individuals. Parents suffering from quasi-arrested old disease may infect their children and outlive them.

(e) Florence E——, æt. 35. *Clinical* : caught cold 16 months ago : never well since : complains of precordial pain radiating down left arm after exertion :

children seven—four dead : some had snuffles. *Previous history*, bronchial catarrh. *Physical signs*, left upper lobe dull to percussion, crepitations in front and behind left apex, and physical signs of a cavity : Tbc. — : dyspnœa + +. *Clinical diagnosis*, fibroid tubercle (?), mediastinitis (?). *Radiogram 54* : in the left upper lobe a condition of fibrosis with small cavities : below these again, dilated tubes : scattered patches in the right lung : right phrenic leaflet irregular. *X-ray diagnosis*, pulmonary fibrosis of left upper lobe with bronchiectasis : possibly gummatous and non-tuberculous. Wassermann not employed.

(f) Edward P—, æt. 28 (4.4.17). Tea salesman : invalided from Army, 1915 : hæmoptysis, two ounces on three occasions ten years ago : cough slight : expectoration small in amount, yellow : Tbc. + : emaciation, one stone : dorsal kyphosis : right lung bronchial breathing and rhonchi locally : fine crepitations on deep inspiration at both apices above clavicles : dulness to percussion : crepitations cleared up after a few weeks. *Clinical diagnosis* : pulmonary tubercle of both apices. *Radioscope*, both diaphragmatic halves move well : apices dull, not opening on cough : heart median, long, narrow. *Radiogram 55*, fibroid nodules and fusiform bands of fibrosis in both apices : small supraclavicular excavations (?) : disease spreading downwards internally and along axilla on right, more centrally on left side : a dense fibrotic opacity between left aortic bulge and apex of left lung : basal emphysema.

(4). *Diffuse granular forms* (P. fibro-diffusa). This type of fibroid disease of the lung may be overlooked by the radiologist, especially when it presents no isolated opacities, but is uniformly grey. It may be erroneously considered to be a thin diffuse pleuritic thickening. Careful examination of a good plate, however, may reveal the signs of an old apical or perihilar excavation surrounded by an opaque infiltration, or dilated perihilar tubes encircled by what appear to be caseous shadows. It is often diagnosed as chronic interstitial pneumonia, especially if the clinical history is suggestive, and the past



RAD. 54 (Ant.)—Syphilitic fibrosis of left upper lobe.



RAD. 55 (Ant.)—Double apical fibroid tubercle.





RAD. 56 (Ant.)—Phthisis fibro-diffusa. Cardiac displacement to left.



RAD. 57 (Ant.)—Quiescent fibroid lung, with thickened pleura on left.



evidence of a tuberculous origin is ambiguous, unconsidered, or ignored.

(g) Bessie C—, æt. 29 (3.10.18). Wasting + : appetite poor: has had pneumonia several times. *Clinical signs*: dulness at left base, heart slightly deviated to the left. *Clinical diagnosis*: fibrosis of the left base. *Radioscope*, deviation of heart and mediastinum to the left: adhesion of left phrenic leaflet to the costal wall externally: outer half immobile. *Radiogram* 56 (anterior), apex of heart to the left: near left hilum at level of sixth rib two small opacities surrounding a dilated bronchus. Both lungs are emphysematous, and the abrupt twist of the ribs on the left side just above the diaphragm indicates old pleuritic adhesion.

Some of these cases are evidently arrested chronic tubercle, since an apical cavitation is present. In the posterior radiogram of this case there were a few small excavations at the left apex. Others are of perihilar origin, and the signs of tuberculosis are obscured by the homogeneous fibrosis, and become revealed only after the employment of laboratory methods. The next radiogram shows a transitional condition.

(h) Katherine W—, æt. 34. Has suffered from a winter cough for years: expectoration —: hæmoptysis —: Tbc. —: breath sounds clear: crepitations outside cardiac apex in front and over the left lung behind, with dulness to percussion. *Radiogram* 57 (anterior), heart slightly pulled over towards the left: metal square on left nipple: a lateral axillary pleuritic thickening over left lung, ending abruptly just below the nipple: acute bending of the ribs on left side: in the right lung a granular appearance, showing a studding of foci along the thickened bronchial tubes: enlarged right hilum, and an unevenly contracted right phrenic leaflet. The crepitations were evidently of pleuritic origin.

Chronic interstitial tuberculosis may occur in association with pure mitral stenosis.

(i) Rosa M—, æt. 35. Cough nocturnal + ; wasting + ; percussion note impaired in the right upper

lobe: sent to X-ray department as incipient tubercle (?). *Radiogram* 58, cardiac outlines of mitral stenosis: both pulmonary fields pervaded by the fine mottling of diffuse fibrosis: emphysema in both lungs, with a tendency to the paralytic thorax. On the right side of the intrathoracic trachea a thickened line, ending below in a slight enlargement (Crane's inverted comma), which is to be regarded as a fibroid metamorphosis of one of the deeper tracheobronchial glands. The comma with its prolongation (fibrosed lymphatic) is a guide to the right border of the trachea. In *Radiogram* 37, Chapter V, mitral stenosis is accompanied by a nodular arrested tubercle.

For the sake of comparison two cases of pneumoconiosis, due to the inhalation of organic dust, are depicted in *Radiograms* 59 and 60.

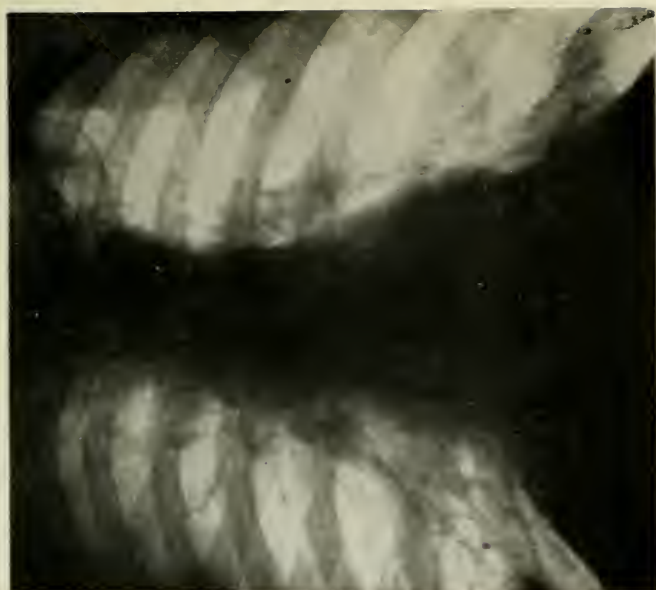
(a) Henry T—, æt. 48. French polisher: has suffered from asthma for five months: heart apex beat normal: chest emphysematous: rhonchi diffused throughout both lungs. The *Radiogram*, No. 59, shows emphysema, phrenic leaflets flattened: heart vertical and median: mediastinum slightly deviated to the left: a fine network of fibrosed tubes most marked in the right lung: slight general dilatation of the right bronchi: both hilar opacities enlarged and fibrous. The resemblance, and at the same time the distinction from interstitial fibroid tubercle, are noticeable.

The affinity of this case with tubercle is exceedingly remote. Occasionally in the elderly, tubercle becomes grafted upon pneumoconiosis (fibro-tuberculous); when this occurs the infection often occupies the right upper lobe, or it may be interlobar. In the latter event the appearance of bacilli in the sputum may be considerably delayed.

(b) Peter H—, æt. 21. Has worked in grain for four years. *Clinical*: cough + : expectoration + : Tbc. + : percussion dulness impaired on the right side in front and behind: rhonchi right lung in front and both bases behind: no clubbing. *Radiogram* 60, the right hilar opacity is very large (a characteristic of dust disease),

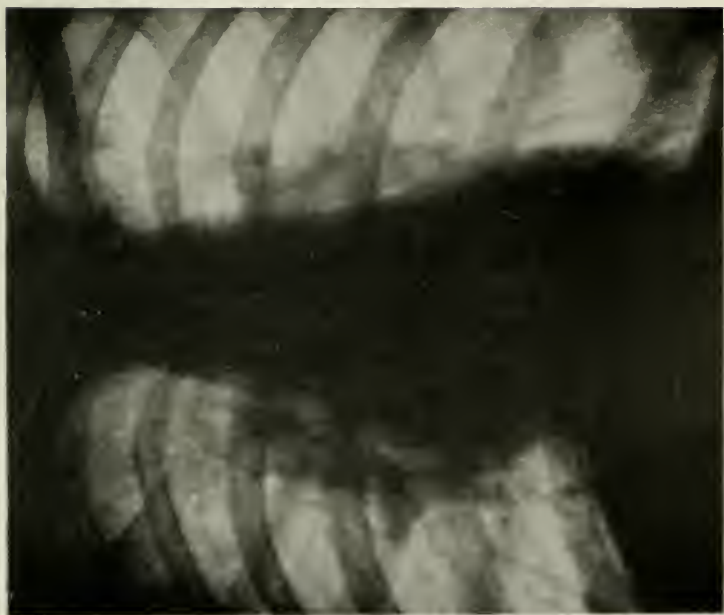


RAD. 58 (Ant.) — Mitral stenosis with slight diffuse fibrosis.



RAD. 59 (Ant.) — Pneumoconiosis of both lungs.





RAD. 60 (Ant.)—Pneumoconiosis with tubercle of right upper lobe.



RAD. 61 (Ant.)—Fibroid phthisis with cavities.



and contains dilated tubes: old infiltrations at the right apex with excavations (only seen distinctly on the plate): a pronounced general striation—possibly disease in this instance first tuberculous, then pneumoconiod.

In coal miners the inhalation of carbon dust is said to play an important part in the production of dense fibroid phthisis. On the other hand, the researches of Tripier and others seem to establish the *inverse relation*, namely, that pulmonary tuberculosis induces the production of pneumoconiosis in dust workers; the presence of the dust hinders the development of existing tubercle, and converts what might become an ordinary common phthisis into a mild, very slowly progressive fibroid form. In other words, it is tuberculo-fibroid in character (*vide* Vol II); and therefore only occurs in miners already affected with tuberculosis. A similar line of thought may be suggested with regard to alcoholism and specific disease when associated with tubercle.

(5) In the cavitary forms *par excellence*, the excavations, when apical, may possess adequate drainage through the bronchi, may become empty, dry, surrounded by a thick capsule, and comparatively innocuous. Their outlines may remain perfectly regular and oval for years; they may contract, or may again become enlarged, eroded, and ragged as the result of mixed infection.

(a) Henry H—, æt. 34. His illness began with an influenza cold two years ago: cough +: expectoration +: Tbc. +: t° 97°-98·4°. *Clinical signs*, percussion note impaired at both apices with crepitations. *Clinical diagnosis*: pulmonary tuberculosis of both apices, quiescent: *Radiogram* 61, one large cavity in each axillary region, "silent" and unrecognised by stethoscope, with fibroid induration surrounding each. Small nodes in each supraclavicular apex. On each side the disease reaches nearly to the level of the hilum. Heart median, narrow.

(b) Horace G—, æt. 36.\* Ex-soldier: *Clinical*: influenza 1918, five weeks in bed: at end of second week hæmoptysis, half-a-pint; in 1916 hæmoptysis, 1 pint:

\* In more advanced stages of this variety the greater part of one or both fields may exhibit a similar radiographical appearance.

cough + : wasting + :  $t^{\circ} 97.4^{\circ}$  : dulness both apices : isthmus, right 3", left  $2\frac{1}{2}$ " : paravertebral dulness : no adventitious sounds. *Radiogram* 62A, areas of nodular fibrosis, small consolidations and small irregular excavations at both apices : disease advancing towards the base on the right : heart median : basal emphysema.

(c) Olivia B——, 62B, æt. 13. An example of marked bilateral fibroid, with cavitation in both upper lobes : in the large cavity on left the openings of the bronchi are visible, and it is crossed by the axillary border of the scapula : there is increased deviation of the heart to the left, and lævo-mediastinum. A few bronchopneumonic nodes are visible in the middle of the right lung. The patient succumbed during the spring epidemic of influenza, 1919.

(d) Fred. B——, æt. 13. An example of unilateral fibroid phthisis (?) : wasting + : coarse features : dyspnœa + : nails incurved : sputum copious : night sweats — : apparent onset four years ago : heart beats felt outside right nipple line : cavitory signs in front *at the base* : over the back râles in right lung : bronchial breathing and bronchophony at the left apex : crepitations at the left base (consolidation ?) : moist crepitations over the right side in front. *Clinical diagnosis* : fibrosis (tubercle ?) of right lung. *Radiogram* 63A, anterior : right lung contracted : left hypertrophied, reaching middle line at cardiac apex : dextro-cardia : dextro-mediastinum : dextro-trachea : on right side upper arrow points to the ascending aorta, which was seen beating in the middle of the right pulmonary field : the lower, to the bifurcation of the trachea : on the left side the arrows indicate the aorta, and the scoliosis cardiac apex. *Posterior Radiogram*, 63B, the middle of contracted right chest is occupied again by ascending aorta : a large apical cavity (arrows) : bifurcation of trachea on right of spine (arrows) : several small cavities and dilated tubes below : cardiac outlines blurred. Patient seen again two years later ; he has put on weight, has now a healthy complexion, and is in some light employment. The radiographic appearances are unchanged. This case may be one of pure fibroid lung : the apical cavity has thin walls and may be bronchiectatic. Final diagnosis : Pure fibroid lung, bronchiectasis.

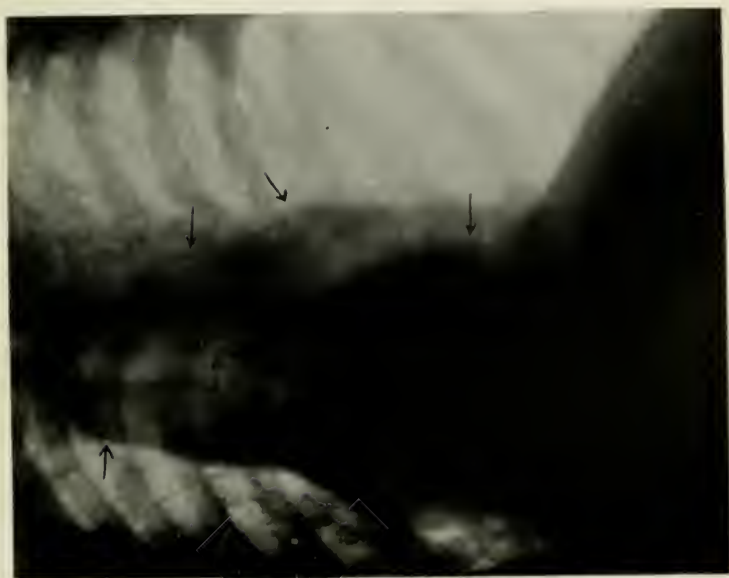
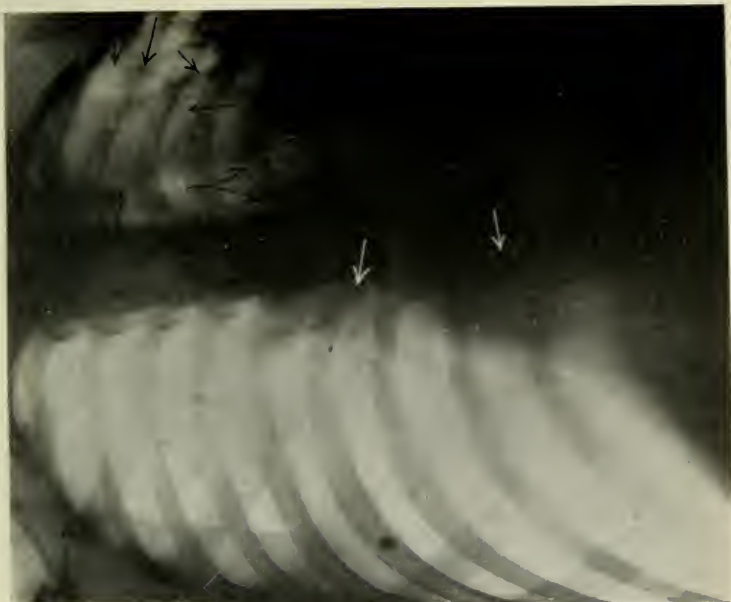


RAD. 62A (Ant.)—Double apical fibroid phthisis. Central microcardia. Emphysema.



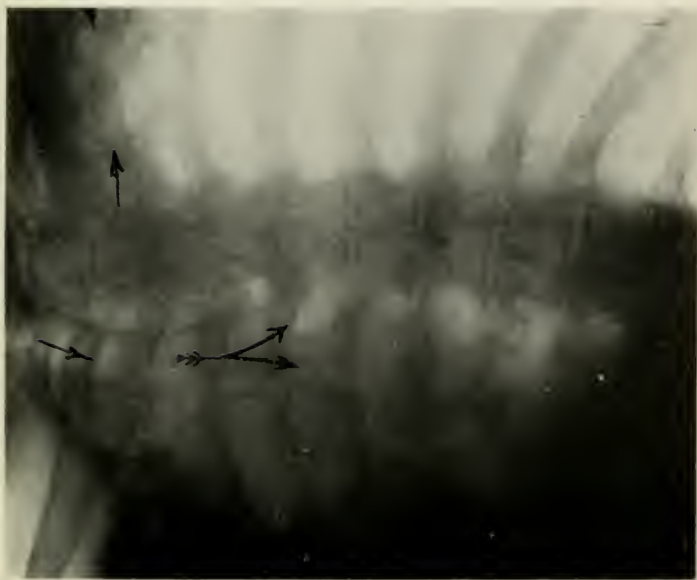
RAD. 62B (Post.)—Fibroid phthisis with apical cavities.



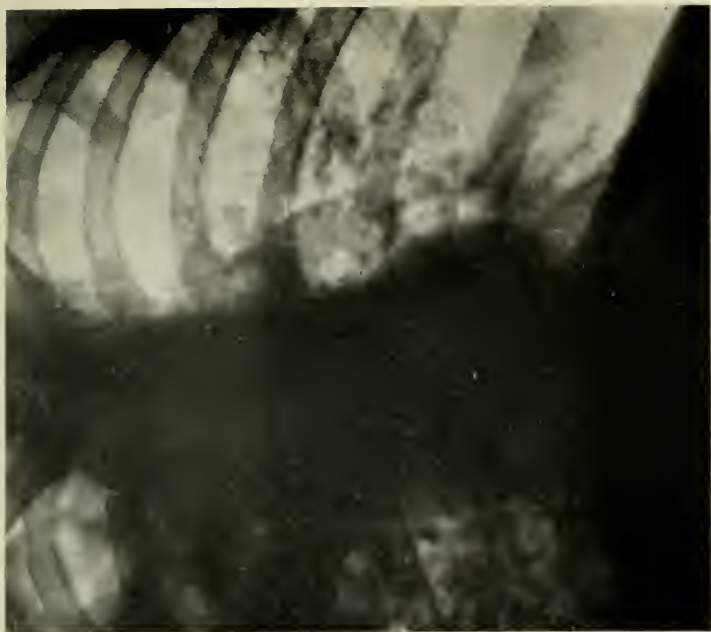


R.A.D.S. 63A and 63B (Ant. and post.)—Pure fibroid lung bronchiectasis.





RAD. 64 (Post.)—Fibroid phthisis of left lung. Cavity right apex.



RAD. 65A (Ant.)—Acute pneumonic phthisis.



(e) Emma B——, æt. 55. Has complained of weak chest for twenty years: had attack of pleurisy ten years ago, and was tapped several times: cough + : expectoration + : Tbc. + (six years ago): complexion good: suffers from dyspnœa: does not appear tuberculous, and has preserved weight. Posteriorly, dulness to percussion throughout: on left side, commencing above, increasing signs of cavity, very marked at base (bronchophony, whispering pectoriloquy, amphoric breathing): on right side expiration prolonged: no moist sounds. *Radiogram* 64, large cavity in left apex, lævo-trachea and its bifurcation (arrows): increased deviation of heart to left: crossing of right lung to left of spine: irregular cavity at right apex—perfectly oval when radiographed in 1913—six years ago. The important features are the marked cavitary physical signs at base, instead of at the apex (acoustic anomaly), and its evolution which is not entirely stationary. Apart from the ragged excavation at right apex, and the entrance of the right lung into the left chest, the condition is *in statu quo*. Prognosis is more favourable when the *right* lung is intact. Lateral scoliosis is present of the same degree as before, convex to the right. There is still a liability to winter colds and slight attacks of hæmoptysis. As regards its precise position, the case probably corresponds to the post-pleuritic fibro-caseous (cavities) type of Bard, with a supplementary *slowly progressive fibrosis* and somewhat favourable prognosis. Moreover, the patient's environment is perfect.

## CHAPTER VII.

## PNEUMONIC PHTHISIS: MILIARY PHTHISIS.

I. *Pneumonic Phthisis.*

*Pneumonic Phthisis* (*Pneumonia caseosa*), as in other types of pulmonary tubercle, may be acute, subacute, or chronic in its course. Although secondary, as a rule, to fibro-caseating cavitary apical phthisis, it may occasionally originate as hilar or perihilar disease; in the latter case evidence of old apical lesions may be found at the autopsy. When a consolidation does not resolve in the usual manner, after an attack of pneumonia, the possibility of a tuberculous infection may be entertained, even if no bacilli are present in the sputum: the explanation of a well marked radiological opacity present in the lower part of the right upper, in the middle, or in the basal lobe, which remains some time after the clinical symptoms and signs have become less severe or have disappeared altogether, is often a very delicate problem. In some cases it is obviously a fibrotic or chronic interstitial pneumonic shadow; sometimes it may be due to a collapse fibrosis after bronchopneumonia, in which the bronchi will become dilated eventually; in others it may be either a pure pneumonic or bronchopneumonic residue in a tuberculous subject, or an actual pneumonic caseation which has assumed a subacute or chronic phase. It may be necessary to examine and re-examine the patient at intervals of two or three months by means of clinical, radiological, and laboratory methods before arriving at a final and satisfactory solution.

Tuberculous pneumonia is characterised post-mortem by the presence of a massive lesion, occupying at least the whole or the major part of one lobe of the lung. Death may supervene in rapid cases in the stage of hepatisation before any material solution has occurred; or there may

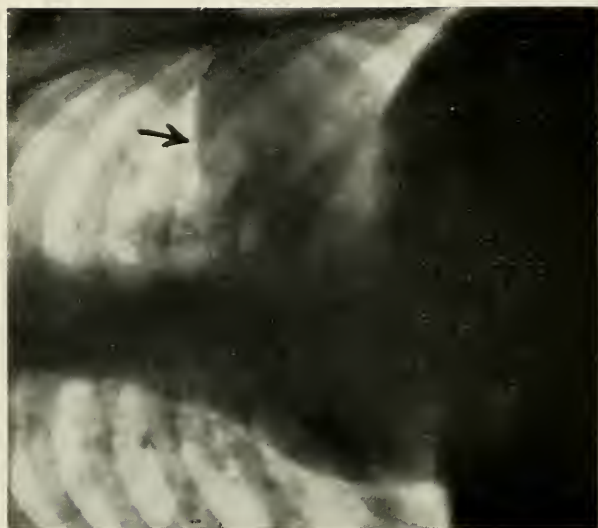
have been time, as generally happens, for the production of diffuse or sinuous excavation of the caseating mass. As regards the clinical features, the physician at first probably considers that he has before him an ordinary lobar pneumonia, until he finds that the crisis has not appeared at the end of the second week, the temperature still ranging between  $103^{\circ}$  and  $101^{\circ}$ , while the weakness and emaciation are becoming more manifest, if not accelerated, and the physical signs of crepitant râles and cavernous sounds still persist. The clinician may then suspect the presence of an encysted empyema or of a massive pneumonia, but the physical signs do not support either impression; during the course of epidemic influenza, the possibility of a subacute migratory bronchopneumonia may be suggested; finally the sputum, which in the meantime may have become purulent, is examined, and a few bacilli may be found, or, if possible, the patient is examined by the rays, a radiogram is taken, and the problem is solved. (Vol. II.)

A summary of the essential and distinctive features may be useful. The commencement of the disease is rarely acute, like that of ordinary lobar pneumonia, with its rigor, pain in the side, and sudden rise of temperature to  $104^{\circ}$ ; on the contrary, there has usually been a preliminary period of a few weeks or months during which the patient has been "out of sorts," with a chronic cough, headache, loss of weight and strength; and he has become increasingly dyspnœic. In some instances the disease is ushered in by a severe hæmoptysis, which renders the diagnosis clear. The sputum may be stained, gelatinous, viscid; it may be simply mucoid; when the lesion softens it becomes mucopurulent, and finally purulent. Often the sputum is non-bacillary; in the case of Radiogram 65A the bacilli were abundant on the first examination. The temperature curve is rarely continuous, but intermittent from the beginning. The physical signs are generally on the right side, in the region of the superior interlobe, above it,

or at the bases behind; occasionally they are limited to the middle lobe in front. There is dulness and subcrepitant râles, and the breathing is more amphoric than in common pneumonia. On the healthier side there may be rhonchi, or the signs of a scattered bronchopneumonia, or those of a dry pleurisy. There may be auscultatory evidence of the existence of arrested tuberculous fibrosis of the right apex; sometimes the radiological evidence of apical cavities, with or without stethoscopic confirmation; it is believed that these cavities act as resonators in the production of the amphoric breath sounds. This conception may also serve to explain the acoustic anomalies in Radiograms 64, 63A and 63B. Pneumonic phthisis is prone to occur during indigence and after chronic neglect of healthy conditions of living; its progress may be so precipitate that death occurs within three weeks from massive toxæmia; more often it runs a course of two or three months, with the formation of cavities and gradual extension to the other lung; exceptionally it assumes the chronic form, and continues as an ordinary fibrocaseous phthisis.

(a) Frederick O——, æt. 24, by trade a fitter: two months before had apparently been in good health: now is suffering from post-influenzal pneumonia: cough+: cyanosis+: dyspnœa+: pyrexia+: clubbing of fingers+: *Physical signs*: crepitations at both apices: behind, dulness on both sides and crepitations: sputum mucopurulent and contains numerous bacilli. *Radiogram 65A*: at the lower part of right upper lobe a dense, practically homogeneous infiltration, reaching nearly to clavicle, and forming nodal opacities below in right middle lobe: signs of old cavitation in the right infraclavicular apex(?): disseminated bronchopneumonic patches extending from the left hilum towards the axilla: cardiac apex slightly retracted towards the right, or possibly a median heart. A large paratracheal opacity on right border of the intrathoracic trachea, not clearly separable from the pneumonic consolidation in the print, but easily on the plate and lantern slide.





RAD. 65B (Post.)—Caseation right middle lobe.



RAD. 66 (Ant.)—Carcinoma right middle lobe.

(b) Radiogram 65B (posterior), was taken seven weeks before death. In the right middle lobe there is a deep shadow, with a definite line of demarcation above, which is practically horizontal, with a curved outline externally: internally the opacity joins that of the heart. In the remainder of the fields a few scattered nodules, left supraclavicular excavations, thickened and dilated hilar tubes. *Post-mortem*: the right middle lobe was almost completely occupied by confluent caseating nodules: in the left apex a cavity, about the size of a hen's egg, *without thickened walls*, and somewhat obscurely seen on the plate. Probably radiograms of the isolated left apex, ventral and dorsal, would have brought the excavation more clearly into view.

(c) Arthur B—, æt. 49 (6.5.19). Family history negative: had pneumonia in India in 1895: pleurisy in 1911: influenza in October, 1918: winter cough for fifteen years: expectoration white and abundant: hæmoptysis, streaks the week before admission: emaciation, four stone: night sweats—: dyspnœa +. *Clinical signs*: scattered sibilant sounds behind on right side: right base dull to percussion, and no breath sounds: chest rigid: crepitations in left lung:  $96^{\circ}$ - $98.4^{\circ}$ : Tbc. negative: *Radioscope*: a dense opacity in the right middle lobe, the right leaflet of the diaphragm almost immobile. *Radiogram 66, anterior*: a dense shadow continuous with the right border of the heart, mapping out the right middle lobe, with a lighter streak between it and the diaphragm corresponding to the right basal lobe. Dissemination spreading to the upper right lobe and to the left lung, apparently lymphatic: spreading through left hilum, many nodal shadows along bronchus running to lower lobe, and also radiating lines running towards the left apex. The posterior view showed that the margins of the opacity were blurred. The diagnosis lies between bronchial carcinoma and caseating pneumonia of the right middle lobe. The absence of bacilli, the very pronounced emaciation, the type of lymphatic carcinomatous dissemination, with very few nodular foci, the absence of pyrexia, are in favour of neoplasm, which, as a matter of fact, it proved to be.

It is convenient here to describe the somewhat infrequent

condition of fibroid tuberculous pneumonia (phthisis hyperplastica tuberculosa) which, according to Tripier, follows a prolonged red hepatisation. Generally, the patient is a chronic or latent consumptive, who is attacked by a lobar-pneumonia which does not resolve, but still shows the clinical signs of a persistent fibrosis (dulness, bronchial breathing, bronchophony). The disease is often fatal within six months or a year; although there is radiological evidence that this period may be considerably prolonged, and the consolidation, when it affects the base of the right upper lobe, and, of a certainty, when it is also accompanied by interlobar adhesions, may shrink, producing a marked diminution of the three upper interspaces.

(d) William R —, æt. 46 : boot maker. *Clinical*: cough for years : now worse : dyspnœa + : Tbc. + : wasting + : dulness to percussion in the right upper lobe : crepitations and catarrhal sounds in the right upper lobe : heart not displaced. *Clinical diagnosis* : pleuritic phthisis. *Radiogram 67*, consolidation in the lower part of right upper lobe, with a well defined lower edge running horizontally : scattered foci present along the bronchi of middle lobe : extreme apices free : signs of excavation in middle of right upper lobe (arrows) : one arrow points to a very large Crane's comma : calcification of rib cartilages and emphysema. On examination six and twelve months later, little, if any, change was noticeable.

## II. Miliary and Submiliary Tubercle.

The differentiation of general miliary tuberculosis from malignant endocarditis and enteric fever—the two diseases for which it is most likely to be mistaken—may be at times very difficult, even after repeated clinical examination, assisted by the most elaborate up-to-date refinements of laboratory technique. Under these circumstances a fluoroscopic examination alone may be advisable, and prove of valuable service; whilst a satisfactory radiogram, if obtainable, may clinch the diagnosis. Before the ophthalmoscope is able to demonstrate the occurrence of



RAD. 67 (Ant.)—Pneumonia hyperplastica tuberculosa right upper lobe. Arrow pointing to Crane's comma accidentally omitted.



RAD. 68. (Post.)—Miliary tubercle, caseating tracheobronchial gland (meningitis tuberculosa).



choroid tubercles, and examination of the urine and cerebro-spinal fluid reveal the presence of the bacillus of tubercle, the fluoroscope may already show cloudy pulmonary fields, and the radiogram manifest the conclusive signs of miliary tuberculosis. The chest may, at the same time, disclose very little information on physical examination: the lungs may even be quite resonant to percussion, and a few scattered râles only may be audible on stethoscopy: whilst the incidence of functional symptoms, such as extreme dyspnœa and obvious cyanosis, may indicate, nevertheless, that a severe pulmonary lesion does in reality exist.

The radiogram shows a more or less uniform permeation of both lungs by innumerable small rounded foci, usually about the size of a pin's head, sometimes a little larger, even smaller; occasionally they may be almost concealed by a thin diffuse opacity, due probably to a summation effect produced by the maculæ situated in the layers of lung lying more distant from the plate. A great deal of discussion has taken place concerning the true interpretation of these miliary hæmatogenous opacities; also concerning the differential diagnosis from peribronchial disseminated nodules, miliary carcinomatosis, and pneumoconiid flecks. The consensus of opinion now appears to be that the maculæ seen on the radiogram actually represent the size and topography of the respective tubercles which lie in immediate proximity to the photographic plate.

The granules are situated for the most part in the walls of the alveoli, in connection with minute vessels, and some may develop within the vessels of the bronchial wall. According to Bard there are cases where the latter localisation is so pronounced as to merit the name of bronchial granule (*la granulie bronchique*). It has been stated by some authorities that *peribronchitic* foci may be distinguished radiographically from pure miliary tubercles by a greater tendency to aggregation and the consequent

formation of larger opacities. Although this occurs generally, it is not always the case. Recourse must then be had to the clinical data (*vide* page 75). The difficulty must be increased in the genuine broncho-vascular miliary dissemination just mentioned. If the plate demonstrates at one apex the existence of an imperfectly evacuated cavity, the chances are that we are dealing with an ordinary disseminated nodular type of disease. Both true peribronchial and real miliary foci are best seen in the middle parts of the chest and towards the scapular areas. In the peribronchial there is, nevertheless, often a more crowded appearance in the upper lobes, and the foci in these situations are slightly larger in size and more irregular in outline than those in the remainder of the pulmonary fields. In pulmonary carcinomatosis the foci, though small, are very irregular in size, and the age of the patient and the presence of carcinoma elsewhere will settle the diagnosis. (See Vol. II for radiogram of miliary carcinomatosis of the lung.) A difficulty may arise from the co-existence of the two diseases in the same lung. In pneumoconiosis from the inhalation of *inorganic* dust the separate foci are considerably larger, they are essentially perihilar, and there are massive hilar shadows, particularly in the right lung.

(a) *Radiogram* 68, posterior: the pulmonary fields are filled by a number of foci of pin-head size. At the right hilum there is an increased shadowing: on the right of trachea, opposite the osseous end of first rib, a slightly convex shadow (arrow). *Post-mortem* examination: meningitis tuberculosa: the lungs permeated by numerous miliary foci: a small gland the size of a bean reaches about 1" outwards from the superior vena cava (softened with caseating contents): at the right hilum several softened and one large caseating gland. The small submiliary foci of the radiogram correspond to the miliary tubercles of the lung as disclosed by the post-mortem. The caseating gland in the right hilum and that on the right side of the S.V.C. are also represented on the radiogram.





RAD. 69 (Post.)—Miliary phthisis. (Compare with Rad. 68.)

Miliary tuberculous dissemination may be to some extent localised in the lung, and two forms have been described. (1) The *asphyxial form of Graves*, where there is a massive miliary dissemination throughout the lungs, with extreme dyspnœa, due to the mechanical embarrassment of pulmonary oxidation, and negative clinical signs, and (2) the *catarrhal form*, which, according to the intensity of the disease, may appear (a) *bronchitic* with the signs of ordinary bronchitis, and eventually become acute local, or generalised tubercle: (b) *capillary*, and (c) *bronchopneumonic*, in which the physical signs resemble those of ordinary disseminated bronchopneumonic tubercle (Chap. III). Possibly the more severe forms are sometimes due to the irruption of a caseating bronchial gland at the hilum into one of the tributaries of the bronchial vein; in these cases there may be a more crowded dispersal through the S.V.C., right ventricle and pulmonary circulation. Miliary tuberculosis of the lung may occur after measles, pertussis, and influenza, with which increased activity of tracheo-bronchial and hilar glands may be associated. After these infectious fevers there may also be a more or less general cylindrical bronchiectasia, with a somewhat copious expectoration. Pyrexia is irregular, and there may be morning remissions, wasting, loss of strength, and enlargement of the spleen.

(b) Elizabeth F —, æt. 15, is just recovering from pertussis: there is a somewhat copious (one ounce or more per diem) purulent expectoration, devoid of bacilli: dyspnœa: an evening  $t^{\circ}$  of  $102^{\circ}$  or  $103^{\circ}$ , with morning remissions: anæmia: pallor: loss of weight and strength. Physical signs insignificant and indefinite. The condition became aggravated, and death occurred about eight weeks after the radiogram was taken. The latter (69) shows a slight diffuse cylindrical bronchiectasia, and a wide distribution of small foci, particularly in the wings, with no disposition to aggregation, and all practically of the same size.

A mild curable type of pulmonary miliary tuberculosis (tuberculosis miliaris benigna) was isolated by Pallard, in

1901. He described 18 cases, the diagnosis of some being confirmed by autopsy. The patient is often elderly, or at least middle-aged, complains of headache, loss of appetite and strength for perhaps a month after influenza, bronchitis and the like. There may be a family history of phthisis, and the patient may be subject to winter cough, or may be actually suffering from mild attenuated or chronic fibroid tubercle of the lung. The physical signs are indefinite, perhaps, at one apex, usually the right, there is tubular breathing and an absence of adventitious sounds (fibrosis). Bacilli may not be present in the sputum. There may occasionally be a small hæmoptysis. The pyrexia, which varies from  $102^{\circ}$  of an evening to  $98^{\circ}$  of a morning, may last for three weeks. In the aged the course is often apyrexial. In one case, radiographed by the author, the patient was over 60 years of age, was ordinarily thin, but now had become emaciated. She complained of severe headache, and, in fact, became somewhat peculiar in behaviour and disposition, suggesting a dissemination of foci within the meninges, a possibility which does not appear to have been mentioned by alienists. The radiogram showed numerous very small foci, uniform in size, in the right upper lobe, and particularly in the axillary region. According to Pallard these foci may resolve completely, or produce fibroid specks, which may unite to form patches of fibrosis.

(c) Arthur H—, æt. 47. Illness began nine years ago with pleurisy. *Physical signs*: at the right apex tubular breathing, increased vocal vibration, no added sounds: Tbc. +. The Radiograms (70A and 70B) show a dense infiltration at the right apex, with excavations better seen on the posterior plate, and some indurated patches reaching towards the hilum. On the posterior radiogram there are numerous very small dark foci, probably fibroid and miliary, which appear to be coalescing to form a festoon below the dense induration. It is possible that some of the foci are pleuritic. Stereo-radiograms might solve the question.

Partial miliary dissemination is by no means uncommon



RADs. 70A and 70B (Ant. and post.)—Right apical fibroid consolidated tubercle with cavities.



during the course of chronic phthisis, and may be recognised on the radiogram.

(a) *Radiogram 71* presents difficulties. James J—, æt. 65. His illness began three weeks before the radiological examination was made, and on the day following a severe physical and accidental strain, in which the patient was compelled to sustain for a short time a massive weight, fit only for four men to lift. Next day he began to expectorate, and during the course of the same day he had a hæmoptysis of one ounce: then slight night sweats and headache. Auscultation was indefinite. The radiogram shows aortic sclerosis with fusiform dilatation, a narrow heart, somewhat dense hilar opacities with several calcareous nodes, and a distribution of fine foci at the sides of the chest. On re-examination four weeks later these had disappeared, leaving slightly clouded areas. In the radiogram all the foci are small, they show no tendency to aggregate: a few run, possibly fortuitously, along the bronchi: are they miliary or bronchogenic? The rib cartilages are calcified, and the chest tends to assume the paralytic type.

## CHAPTER VIII

## THE COMPLICATIONS OF PULMONARY TUBERCULOSIS

*Pleurisy*

For many years clinicians and pathologists have discussed the question as to the existence of *primary* tuberculous pleurisy, produced by the autonomous and independent deposition of tubercles within this serous membrane, and the manner in which the infection is carried to it. The possibility of its occurrence may be admitted, also the probability that the bacilli may be conveyed in some manner *viâ* the lymphatic circulation. Tuberculous pleurisies have consequently been divided into (1) *primary*, and (2) *secondary*. The former have again been subdivided into (a) *the superficial* and (b) *the deep*, in the latter of which the subjacent pulmonary tissue participates. The *secondary* pleurisies arise from tuberculous lesions occurring in the neighbourhood—the lung, the ribs, the dorsal vertebræ and the peritoneum, or they are the result of a widespread infection like that of generalised miliary tuberculosis. In the *primary* tuberculous pleurisies the effusion will constitute therefore the first *radiological* manifestation of the disease. Radiological examination made before, and subsequently to the evacuation of the effusion, gives no support to the view—either active tuberculous foci are present already within the lung, or there is ample evidence of a latent or quasi-latent tuberculous infection of the hilar or perihilar areas. For these reasons the so-called post-pleuritic types of pulmonary phthisis (Bard) are more accurately described as varieties of tubercle in which pleuritic effusions and adhesions impress a particular character upon, and exercise a preponderating influence over, the evolution of the disease. The following case illustrates





RAD. 71 (Ant.)—Disseminated miliary foci in left axillary lines.  
Calcareous nodules along left edge of aorta.



RAD. 72 (Ant.)—Right interlobar pleuritic thickening.

some of the points at issue, and at the same time the utility of radiological examination for the purposes of diagnosis.

CASE 1.—John——, æt. 50. Had pleurisy twenty years before: hæmoptysis six weeks ago with night sweats, pain in the right side, dyspnœa and some loss of weight. On the right side, in front and above, percussion note impaired: vocal resonance *diminished*: breath sounds weak: right side, behind and below, vocal resonance increased and breath sounds loud. *Clinical diagnosis*: unresolved pneumonia. *Radiogram 72* shows a well defined lower edge of the right upper lobe with an interlobar pleuritic thickening and adhesion: tuberculous *infection* in the shape of thickened dilated tubes and small indurated foci in right upper lobe: "inverted comma" conspicuous along the right border of the trachea (arrow): some general cylindrical bronchiectasia and indurations along certain bronchi of the right middle lobe. There is some contraction of the right upper chest, slight deviation of the heart and mediastinum towards the right side, and irregularity of the outer half of the right phrenic leaflet: hilar fibrosis on the left side, and dilatation of tubes: also dilatation of the ascending aorta.

The case bears some resemblances to the benign type isolated by Piéry, and termed by him pleuritis tuberculosa recidivans (pleurite tuberculeuse à répétition). It is possible that a genuine bronchiectasis may ultimately be produced beneath the interlobar opacity.

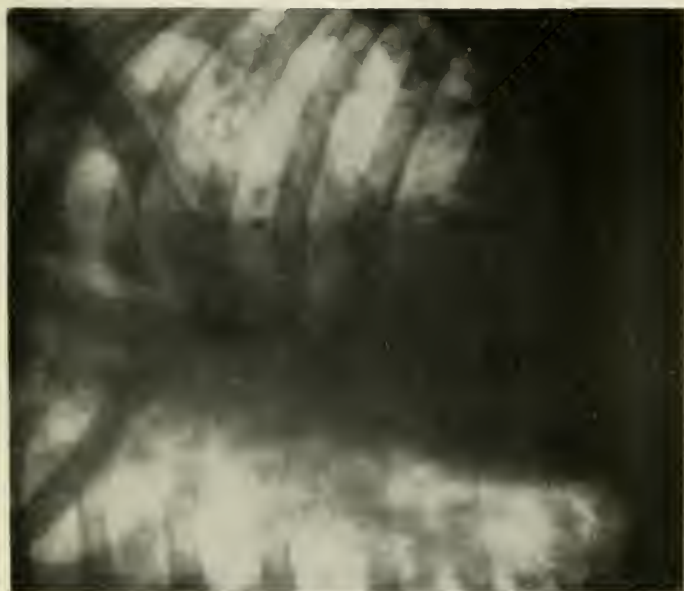
*Secondary* pleurisies, with or without effusion, occur so frequently during the course of pulmonary tuberculosis that they may be regarded, not so much as complications, but as a natural consequence due to the play of the defensive powers of the organism. Beside the pleurisies with large effusions, one often meets with pleurisies in which the effusions are insignificant, commencing insidiously, and at times overlooked. The radiographical appearance is not always characteristic, since the effusion may occur within a pleural cavity limited and deformed by adhesions—moreover, the amount of fluid may not be

sufficient to produce displacement of the heart and mediastinum, or these organs may already be fixed by previous disease. As a rule the fluid is serous, generally basal, and it is more commonly found in men from 20 to 40 years of age, and on the left side.

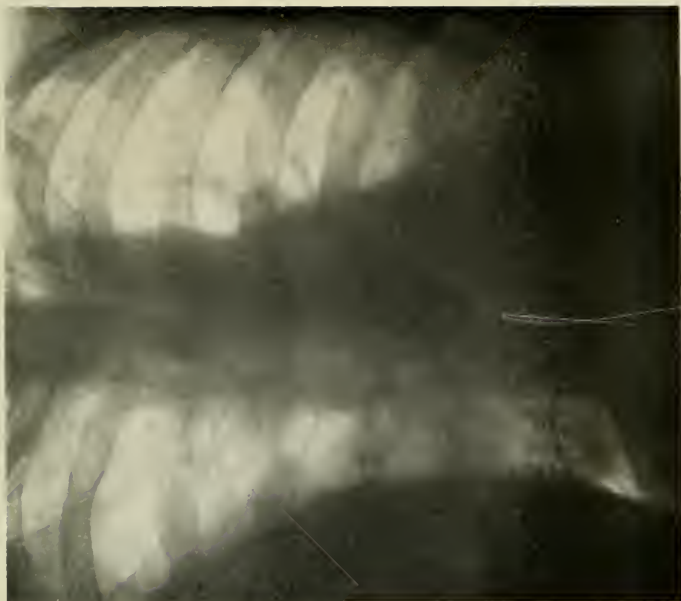
CASE 2.—Richard F——, æt. 28 years : suffered from pleurisy ten months ago : cough + : expectoration + : Tbc. + : dulness and loss of movement at the left base extending above the left nipple : crepitations in both upper lobes : heart apex beat not found. *Diagnosis* : phthisis of both upper lobes, with effusion at the left base. The *Radiogram* (No. 73) shows a disseminated tubercle with dilated tubes in both lungs : irregular cavity at left apex beneath middle of left clavicle : excavations (?) in right apex : an effusion at left base, the upper edge of which runs upwards and outwards : slight deviation of right auricle to the right, and of upper mediastinum to the left. A metal square on the left nipple (seen in plate, not in print) appears in the middle of the opacity. On standing, the distance of the upper line of the effusion from the disc was *one inch higher* than in the recumbent position.

Collections of *encysted* fluid may occur in any part of the chest. They are commonest in connection with the right upper and lower interlobar fissures.

CASE 3.—Henry F——, æt. 30 years : suffers from cough at night : expectorates about one ounce of sputum per day : there are night sweats : a temperature occasionally 100° of an evening : there is dulness at both bases, crepitations in the right lower lobe : heart not displaced. *Clinical Diagnosis* : chronic pleurisy with effusion. *Radioscopic examination* : on the right the diaphragm *moves well* : there is an area of dense opacity at the right base, of the same appearance in front and behind : *Radiogram* 74, a large encysted effusion at the right base (connected with the lower fissure ?), thickened pleura at the left base : slight deviation of the upper mediastinum and trachea to the left : fibrosis or collapse of the middle lobe : slight illumination at the base due to basal lobe : some old nodules at right supraclavicular



RAD. 73 (Ant.)—Pulmonary tuberculosis. Effusion left base.



RAD. 74 (Ant.)—Right interlobar effusion.



apex. On puncture a straw-coloured fluid was obtained which contained tubercle bacilli.

*Localised adhesions* may remain after the absorption and evacuation of effusions, or may be the result of a dry pleurisy. Simple thickenings of the *visceral* pleura may occur at the apices, interlobes, diaphragm, and in the mediastinum. *Over the apex* they may form a thick cap, concealing deeper lesions. This is often seen as an opacity in the posterior radiogram, running parallel to the lower border of the second rib. Pleuro-visceral adhesions at the apex may lead to pain, diminished movement, weak breath sounds, or interrupted breathing, with friction sounds and retraction of the fossa. The opacity in the supraclavicular region may be more obvious posteriorly, both sides therefore should be examined by the rays. If *basal*, the diaphragm may be rather sluggish, but on its descent should show a narrow band of opacity parallel to its upper margin.

Thickenings of the *parietal* pleura are commoner at the base, and may produce adhesions between the diaphragm and the ribs. Costophrenic adhesions are not uncommon on the left side. Occasionally the whole of one half of the diaphragm is immobile and fixed to the ribs, producing dulness at the base, and leading to the clinical diagnosis of basal effusion, unresolved basal pneumonia, or basal fibrosis. If the adhesion is slightly yielding, there may be an inspiratory tremor in the diaphragm without descent (Radiogram 84). Adhesions of the diaphragm to the ribs, the remains of old dry pleurisy, may retain the diaphragm at one or more localities, which are best seen during inspiration. A common situation is at the level of the main basal bronchus (*phénomène du feston diaphragmatique*, Radiogram 41). Mediastinal adhesions are shown by disfigurement or irregularities of the cardiac outline on one or both sides, and by thin shadows below the inner end of the right clavicle, running parallel to the sternum. Thickenings limited to the axillary region

may be present (Radiogram 57). Cardiophrenic adhesions are common (*vide* Vol. II).

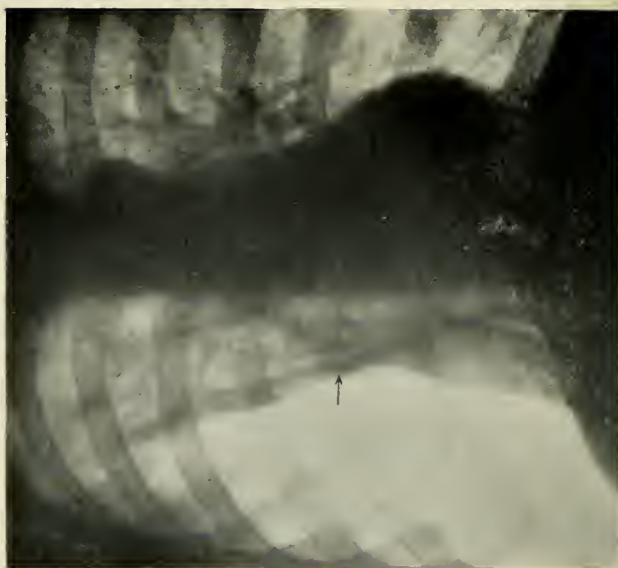
Diffuse pleural adhesions (*concretio diffusa*) may occur, obliterating the pleural cavity, with or without thickening of the membrane; *in the latter case* there may be *little or no loss of transparency* on the radiogram. The diagnosis then depends on the position of the ribs, the narrowness of the interspaces, a sudden bending of the ribs in the axillary-line, scoliosis of the spine, the convexity towards the healthy side (Radiogram 64), abnormal respiratory movements, such as the cradle or see-saw movement of the lower part of the chest. In other cases diffuse thickenings (visceral?) may occur without adhesion when the whole of one side of the chest appears opaque; occasionally more intense patches of opacity may be seen through the shadow, due to infiltrations of the lung. In some instances the opacity is so thick that nothing can be ascertained as to the state of the subjacent lung; moreover, in the earlier stages there may be little or no constriction of the chest. Information as to the existence of tubercle may be gained by contrasting anterior and posterior radiograms, and by careful examination of the more transparent lung. Failing these, recourse must be had to laboratory methods for diagnosis.

CASE 4.—Mary W——, æt. 39, has had a weak chest from a child: pleurisy three years ago, ill then for two months: pain in chest: cough + : expectoration — : dyspnœa — : palpitation + : night sweating + : wasting + : at left base dulness, and sinking in of lower ribs below the seventh during inspiration and movement towards the right side (see-saw movement). The radiogram, No. 75, shows a pleural symphysis on the left, in which the pleural leaves are but slightly thickened, and fibrosis of the left upper lobe. Re-examination, after eighteen months, showed an improvement and a diminution of the cradle movement. Scaphoid scapula on left (arrow). The right lung and hilum show changes due to obsolete tubercle.





RAD. 75 (Post.)—Left pleuritic symphysis. Arrested phthisis.



RAD. 76 (Ant.)—Right pneumothorax with quiescent tubercle and congestion of left lung.

*Pneumothorax*

Pneumothorax is one of the difficulties of physical diagnosis, one of the easier problems for the radiologist. The commonest seat of tuberculous pneumothorax is near the diaphragm in the axillary line (Radiogram 32), and its size may vary from that of a large cavity to that of half a lobe of the lung: in certain cases, where adhesions are not present, the whole lung may collapse and appear as a mere stump at the hilum. In pulmonary tuberculosis this is rare, since adhesions are practically always present either at the base or at the apex of the lung.

CASE 1.—Thomas G——, æt. 33. Had pleurisy on the right side one year ago: has had pain between the shoulders and on the right side of the chest: at the right base the breath sounds are faint, vocal resonance is absent: there are no crepitations, but there are crepitations at the left apex: heart not displaced. *Diagnosis*: undetermined (because pneumothorax was not suspected). The diagnosis was made clear at once by the radioscope, since there was a bright area of illumination at the right base. Radiogram No. 76 confirms the diagnosis of pneumothorax, due chiefly to collapse of the right middle lobe with a disseminated tuberculosis of low-grade activity, and congestion in the left lung.

The progress of recovery of the lung should be ascertained by repeated radioscopical examinations: six weeks' rest may be necessary for complete re-expansion. The same routine should be employed in cases of *operative pneumothorax* after empyema. Very often patients are sent out of hospital with one lung half collapsed, since the surgeon does not think of its condition. Sometimes in cases of spontaneous pneumothorax a posterior view will show how the right middle and right upper lobes separate during inspiration as the air enters the collapsed lung (*vide* Vol. II, "Empyema"). When the pneumothorax contains fluid insufficient on the one hand, or in excess, so that *audible* succussion is not obtained, the physical diagnosis is still more difficult. It is often diagnosed by

skilled clinicians as fibroid lung. The radioscope, the patient being in the vertical position, shows a clean cut, horizontal fluid line, an air space above it, and *visible* succussion.

CASE 2.—Thomas N——, æt. 32 years: cough for one year: weakness: emaciation: tubular breathing at right apex: crepitations both apices: and splashing. Radiogram No. 77 shows a right hydro-pneumothorax, about two-thirds full, with excavations at the left apex.

These effusions are usually left alone, unless symptoms, such as urgent dyspnœa and distressing cough are present. The absorption of the fluid usually requires a considerable time—maybe six months or more—and leaves behind it a greatly thickened pleura, the horizontality of the upper margin of the opacity becomes lost; it may now run obliquely upwards and outwards.

In pneumothorax there is generally a marked *inspiratory deviation of the mediastinum* towards the diseased side, and in the erect position, if fluid be present, and the cavity not more than one-third full, the level of the effusion rises during the same period of respiration. If empty, certain curious paradoxical movements of the diaphragm are observed (*vide* Vol. II, "Pneumothorax"). Metallic tinkling is not frequent in pneumothorax—about 30 per cent. It has been attributed to the dropping of fluid on the surface of the effusion, or to the bubbling of air ascending through the liquid during inspiration from a fistulous tract in the lung situated beneath the level of the fluid (Norris and Landis, p. 129). Since this tinkling—it has been compared to the sound produced by the falling of grains of sand into a wine glass—may be audible in a pneumothorax *devoid of fluid*, and also in *operative pneumothorax* after empyema, where there is no doubt as to the integrity of the visceral pleura, the above explanation does not satisfy all cases. Skoda and other authorities also have considered the presence of fluid unnecessary for its production. They thought it might be due to the propagation of mucous râles through an air chamber acting as a resonator. It



RAD. 77 (Ant.)—Right pneumothorax with effusion. Cavitation  
left apex.



is heard during inspiration, coughing, and change of position. In one case, without fluid, auscultated by the author, it was heard best just over the displaced and mobile mediastinum, so that it is possibly due to the stretching of adhesions produced by the inspiratory movement of the mediastinum itself. The heart and mediastinum, unless fixed by adhesions, are pushed over towards the healthy side; this is more obvious when the pneumothorax is on the left. In some instances, especially in artificial pneumothorax, the mediastinum yields at one of its two weak spots—one in front of the ascending aorta between it and the sternum—a bulge appearing on the healthy side: or just behind the heart about the level of the eighth or ninth vertebra; a protrusion then appears at the base. These may be termed the *superior and inferior ballooning* of the mediastinum. The complication very rarely happens in spontaneous pneumothorax; the author has seen one case where superior ballooning occurred.

It has been already stated that the radiogram may exhibit calcareous, obviously subpleural foci, in the near vicinity of a spontaneous pneumothorax (R. 32 and R. 76): at other times such foci are not obvious. In Rad. 76 there is a slight deviation of the heart, so that the vertebral column is just visible. The absence of deviation to palpation, in cases of right pneumothorax, may mislead the clinician, since the heart may be originally median, with little protrusion to the left, a circumstance which is frequent in tubercle.

### *Emphysema*

During the progress of pulmonary tuberculosis the chest may assume an inspiratory emphysematous position, or the ribs may sink and the interspaces become narrow, producing the flat chest (thorax aplati or paralyticus). Also partial, vicarious, or compensatory emphysema is common. Compensatory emphysema is limited to particular areas; for example, a single or double apical tuberculosis may lead to dilatation of the bases, and

finally to emphysema. In other cases there may be a localised apical emphysema, especially in women, and particularly involving the second right interspace. Occasionally the middle chest is expanded (annular). Localised and diffuse emphysema may be associated with many non-tuberculous affections, such as chronic bronchitis, atheroma, and dilatation of the aorta, myocardiac degeneration, and pressure on the main bronchi by neoplasms and aneurysms; but, as a general rule, double hypertrophic emphysema is paratuberculous; in other words, it is to be regarded as the outward expression of a chronic pulmonary tuberculosis. The radioscopical and radiographical features are given in greater detail in the second volume; a few of the salient characters are mentioned here. In all cases the *crural* as well as the *sternocostal* halves of the diaphragm must be examined; in well marked cases of emphysema, while the sternocostal or frontal diaphragm is flat, deep, and practically immobile, the crural or posterior diaphragm may be working well. In very severe cases of generalised emphysema, occurring in old asthmatics, and after serious gas attacks in young men, the crural diaphragm may also lose its movement and may be pushed down. Under these conditions there is a condition of complete diffuse hypertrophic emphysema; a central or perihilar emphysema is superadded, and the dyspnœa becomes extreme. As a contrast to this condition, very occasionally one sees a case of apparent emphysema where the sternocostal and costal diaphragms show little or no abnormality either in movement or position. They are difficult to explain; possibly they are due to a loss of elasticity in the bronchi alone, which produces a general cylindrical bronchiectasia.

On the radiogram a variety of tuberculous conditions are associated with well marked emphysema, (a) enlarged hilar and paratracheal opacities, either with or without cylindrical bronchiectasis; (b) basal emphysema may develop in the presence of ordinary apical fibrocaseous disease, and in the absence of basal pleuritic adhesions;

(c) a chest originally flat—thorax paralyticus—scarcely, if ever, assumes the expanded condition of emphysema, except in its lower parts. The ribs do not run quite horizontally as in the usual cases of emphysema. The asthmatic chest is often a modification of this form—very much hyper-inflated below, with enlarged hila, a conspicuous bronchial arborisation within the lung, perihilar and other infiltrations possibly becoming arrested, or liable to recurring attacks of perihilar congestion, with some thickening of the bronchial walls, and a median narrow cardiac opacity. (d) In other instances there may be a bilateral disseminated nodular or nodal fibroid phthisis, the small dark and irregular maculæ and nodes of which are connected by a fine reticulum, or by fibroid strings, with enlarged hilar and fibrosed right paratracheals. Occasionally the disease is unilateral, disseminated, or dense, and the healthy lung is hyper-inflated only, passing across the spine into the diseased chest. As the result of radiological observations it may be suggested that (a) diffuse emphysema is *primary and inspiratory in origin*; that (b) calcification of the first costal cartilages, instead of being an element in the ætiology of the disease, is an effect, and acts, along with later calcification of the lower ribs, as a safeguard against excessive expansion. In the gas poisoning of soldiers, where emphysema may become extreme, the rib cartilages remain quite soft and invisible to the rays. (c) Rigidity of the chest in the *mean* respiratory, or in the expiratory position, in the aged is due to the presence of many calcified cartilages; in the young adult it may be associated with an extensive adherent pleurisy.

### *Hæmoptysis*

may be an early event in pulmonary phthisis; it may occur on several occasions during the course of the disease, or it may be copious and terminal. In the earlier and median stages it may be a mere staining of the sputum, an insignificant spot, a minute clot, or it may be abundant and

amount to more than twenty ounces. Non-tuberculous sources of hæmorrhage, like mitral stenosis, aneurism, bronchiectasis, the gums, retro-lingual varicosities, the pharynx and fauces (and malingering), are usually excluded by the physician. It is not considered expedient to bring a patient to the X-ray department earlier than about ten days after a severe attack of hæmoptysis; during this interval any changes in the density of the fields may have become less evident. Nevertheless, with a soft tube and a short exposure it may even then be possible to verify the stethoscopic localisation of its source. There may be one or more caseating foci in one of the apices, surrounded by a network of what appear to be not bronchi but enlarged vessels—lymphatic or otherwise—there may be the remains of an interlobar effusion concealing the right upper lobe, which disappears after some few weeks, revealing nodular foci or a pneumonic patch beneath; or there may be an irregular fluffy area of infiltration at the osseous extremity of the first rib on the right, which suggests an active condition. Such instances of earlier hæmoptyses may therefore be termed (*a*) congestive, (*b*) pleuropneumonic, and (*c*) pneumonic. In the early congestive forms it may be the accompaniment of mild minor phthisis only, with no pyrexia, no bacilli, and an appearance practically normal.

On reviewing a large number of radiograms of cases in which hæmoptysis — small, medium, and severe — has occurred, one is struck (*a*) by the fact that very often localisation of the bleeding point is a pure speculation; (*b*) by the not uncommon occurrence of cloudy irregular hilar and perihilar or interlobar opacities without any other changes; (*c*) by the constant association of small or medium, very occasionally severe, hæmoptyses, with the presence of disseminated nodular foci, and of cavities within the apex or other parts of the lung; (*d*) and by the frequency of small hæmorrhages in the fibroid lung. In the two latter the hæmorrhage is probably due to erosion of arterioles within existing cavities. Very often

a copious hæmorrhage in early tuberculosis connotes a more favourable prognosis than frequent streaking of the sputum and repeated small hæmoptyses. A perusal of the radiograms already given will illustrate these paragraphs.

### *Cavities*

are recognisable on the radiogram by their thickened edges, their oval shape, their central translucency, which may approach that of normal lung, and even surpass it. Excavations are sometimes found at the autopsy which are invisible on the plate, because their edges are often thin and indefinable; they may be uneven and ragged; or the cavity may lie in the midst of healthy tissue. Sometimes a cavity is visible in one radiogram, usually the posterior, and is almost or quite invisible in the anterior; it is therefore missed if the anterior position alone is photographed. In other cases the surrounding tissue is infiltrated or fibroid, or a dense layer of thickened pleura covers it. If the cavity is partially or completely full of vascular and tissue debris, or if it is filled with secretion, it is not clearly defined. An enclosed circular space or loculus, clearer than the rest of the cavity itself, may be due occasionally to a dilated bronchus.

Pleural stripes and thickenings, lung cicatrices, etc., may be so arranged as to simulate a cavity with thickened wall; the presence of lung structure within the circle may settle the question; optical sections of dilated bronchi, especially in the perihilar areas, often prove a difficulty. Opaque infiltrations within the supraclavicular and infraclavicular areas, containing oval, so-called clover-leaf-shaped transparencies, are often due to the presence of small, old, dry excavations; sometimes they are dilated tubes, at other times genuine cavities. In cases where irregular masses of induration form, the excavations appear as sinous and irregular transparencies; in some instances these are dilated and tortuous tubes.

In the very early stages of a cavity, where necrosis of tissue has occurred, without solution of the contents, the

presence of an opaque ring is characteristic. The interior may appear normal. In other cases the annular opacity is incomplete, and may remain unfinished.

Fred S——, æt 23, complains of cough, dysphagia, wasting: *no adventitious sounds*: there is a small ulcer on the free edge of the epiglottis. *Radiogram 78*: disseminated fibroid tubercle of both apices. One cavity in each apex, probably not quite empty, and the commencement of a second in right apex below the first (arrows).

There is no doubt that cavities are much more easily diagnosed by radiography than by clinical methods. The former shows cavities in situations where they may be unexpected, and it gives precise information—especially if stereoradiograms are taken—of their size, depth, and contents. If quite empty the prognosis is more favourable (Chapter III). As a rule no clean-cut fluid level is obtainable, even in large cavities—either they are empty, the contents are semi-solid, or are so tenacious that they stick to the wall. Cavities are not discernible by the stethoscope unless they are fairly superficial, reach the size of a walnut, and are surrounded by infiltrated tissue. As long as they do not contain air they do not give the usual physical signs—only subcrepitant râles and seldom bronchial breathing. Until they are thoroughly emptied, there is always the danger of dispersal throughout the lung, and the formation of new tuberculous foci and of laryngeal and intestinal complications.

The thickness of the wall is a criterion of its age. A thick-walled cavity may exist unchanged for years; but if subjected to the effect of mixed infections it may enlarge and become irregular in shape. (*Radiogram 64*, right apex.) When very large, a cavity may be mistaken for a small pneumothorax. (*Vide Vol. II.*)

### *Bronchiectasis*

In chronic pulmonary tuberculosis dilatation of the bronchi is a common complication; sometimes it is sufficiently advanced to constitute a true bronchiectasis, and



RAD. 78 (Ant.) Fibroid peribronchial tubercle of both apices with cavities



RAD. 79 (Ant.)—Quiescent tubercle, left paracardiac bronchial dilatations.



at first sight may mask the genuine disease. It may be present as a general cylindrical dilatation throughout both lungs; as definite bronchiectatic cavities at the base, in exceptional cases, large bronchiectatic cavities may even be found in the upper lobe. A sputum examination may reveal the presence of bacilli; in other cases they are continuously absent, when the suspicion of non-tuberculous lesions naturally arises. Clubbing of the fingers accompanies bronchiectasis, whether it is primary or if it is a complication of tubercle.

Mary G—, æt. 32, has suffered from cough since childhood; and now from a winter cough for years: the sputum is scanty, bacilli are absent, the weight is stationary. At present the chief complaints are cough and great lassitude. *Clinical signs*: creaking sounds near left nipple, dulness, rhonchi in both lungs, crepitations at the left base. *Radiogram 79*: several dilated bronchi (left paracardiac) just outside cardiac apex: thickened tubes, especially the right paravertebral, throughout both lungs: emphysema, particularly of the right side: a slight deviation of the mediastinum towards the left: and the general appearances of old arrested tubercle in both lungs.

It appears to be an old latent perihilar disease, probably first occurring in childhood, in which the typical bronchiectatic sputum has never developed, but the lesion has left dilated bronchi as the clinical indication of its previous existence. Several of the previous radiograms show the presence of a cylindrical generalised bronchiectasia (Radiograms 17, 50, 69, etc.) as a side-issue of the genuine tuberculous disease (Vol. II, "Bronchiectasis"). It has been already stated that the co-existence of the two lesions, especially if the bronchiectasis is local and conspicuous, suggests the possibility of a specific infection.

## CHAPTER IX

## THE RADIOLOGICAL DIAGNOSIS OF PULMONARY TUBERCLE.

*Preliminary Observations*

CAREFUL perusal of the foregoing chapters will convince the reader that in several forms of pulmonary phthisis the sputum *may not*, and probably *never will*, contain the bacilli of tubercle. In other words, there are numerous cases in which the lesions are permanently *closed*.

Secondly, that when the sputum, previously bacilliferous, becomes free, the disease *may* be neither arrested nor cured; and thirdly, that if the diagnosis be confirmed by the discovery of bacilli, the necessity of radiological examination still continues urgent. By means of the latter the locality of the lesions, their extent, their attributes, and the type of the disease are more accurately determined and recorded. In many instances, unfortunately, when the sputum is positive, no attempt to ascertain the essential quality of the lesions is made by the medical examiner; at the same time, it cannot be too strongly emphasised that delay in pronouncing a patient "tuberculous" merely because the expectoration furnishes no proof is dangerous, both to the individual himself and to the community at large.

When properly conducted and the results logically analysed, in so far as the peculiarities of acoustic conduction in the chest are understood, clinical examination is of the greatest value; but if the apices alone are investigated, whilst the deep axillæ, the interlobes, and mammary regions, are neglected, mistakes are unavoidable. For this reason alone X-ray examination is of service; opacities of any size on the plate are at once recognised, even by the less experienced, and a clinical re-examination may confirm the X-ray observations. By the use of both

methods a mutual control is provided, and difficult problems more readily solved. On the other hand, the argument has been seriously advanced that radiological examination leads both practitioner and student into undesirable habits, so to speak; tends, indeed, to make them distrust the results of their own clinical examination—in reality a spontaneous acknowledgment of the value of the X rays. The two methods are dissimilar; each approaches the subject from a different point of view; it is imperative, therefore, that the diagnosis should depend, as far as practicable, on the combined and corroborative evidence of both.

The additional rôle assigned to the radiologist is the determination of the character of the plate; whether it is under, over, or accurately exposed, fully or incompletely developed; whether the X-ray tube was correct in quality, too hard, or too soft. He must also decide what is normal and what is pathological on the radiogram; in the latter event he must differentiate the sharp clean-cut outlines of old arrested lesions from the cloudy definitions of active disease. It has been asserted that one may be unconsciously biassed in the interpretation of the radiogram by a knowledge of the preceding clinical examination; and conversely, that it is easy to find dulness on percussing, râles and crepitations on auscultating localities, where obvious opacities are present on the plate; a statement tending to cast suspicion on the utility of physical examination of the chest in general.

### *Method of Examination*

Incidental remarks follow concerning the clinical signs of the different forms of tubercle: these are appended because the radiologist is often asked to examine and report on patients in the absence of clinical data. He is expected to diagnose the case just as if these had also been supplied to him. The examination should be systematic and orderly: (a) the history of the patient carefully recorded, (b) the symptoms enumerated, (c)

clinical examination as to (1) type of chest, (2) expansion, (3) percussion and auscultation of apices, axillæ, interlobes, interscapular areas, mammary regions, and the bases, (4) radioscopy, (5) radiography, (6) a second physical examination of anomalous radiographical opacities, and of areas to which abnormal intensities of striation are directed. Since the plate is actually the *sine quâ non* for the purposes of diagnosis, it is unnecessary to spend much time on radioscopy—after the outlines of the heart, the condition of the hila, the extreme apices, the movements of the ribs and diaphragm, any abnormal opacities have been observed from *different points of view*, the radiogram should be taken forthwith and any smaller plates, with the addition of stereoscopy, of suspicious areas, if expedient.

#### *Clinical Comments.*

It is said that (1) lessened expansion of one upper lobe, (2) slight increase of apical tactile fremitus and vocal resonance, (3) some impairment of percussion note of one apex, (4) prolonged expiration, (5) post-tussive inspiratory crepitations in the upper lobe, are the earliest signs of tuberculous infiltration. Some authorities have mentioned (1) *granular breathing* at the apex as the earliest sign, (2) feeble breath sounds in the same area, or over the whole of the affected side, (3) interrupted breath sounds, (4) slight bronchial breathing and whispering pectoriloquy, followed later by (5) more pronounced bronchial breathing, (6) medium sized râles, or mucous clicks—the latter of which are said by some physicians to be pathognomonic of tuberculous infiltration—and (7) showers of fine inspiratory râles after cough. Difficulties arise in the clinical diagnosis of the different types, whether incipient or advanced, *e.g.*, of the fibrocasing bronchopneumonic cases, and in particular of the perihilar varieties of this group; of the different manifestations of minor and fibroid phthisis, which *per se* may not reach alarming proportions, but which, even when latent and obsolete, leave behind clinical sequelæ which subsequently may render diagnosis

uncertain. Moreover, classification of such a protean disease as phthisis is liable to become obscured by the implantation of active progressive types upon ancient, apparently obsolete lesions. In the fibroid nodal disseminated forms, with emphysema, percussion is generally resonant except possibly at the apex (areas of fibrosis or pleural thickenings and adhesions); rhonchi, accompanied by moist râles, are often heard during periods of temporary bronchitis and pulmonary catarrh; whilst in the disseminated nodular forms physical signs are extremely feeble and indefinite. Apical fixed rhonchi with some percussion dulness are associated radiologically with localised minor fibroid infiltrations in the neighbourhood of dilated tubes. Mucous râles are present also in caseating pneumonia; and along the borders of consolidations, reactivated by various circumstances, fine râles are to be perceived. The so-called typical tuberculous râle, due to softening of a caseous focus, is moist, generally inspiratory, increased by cough, is localised and fixed; whereas the mucous râles, just mentioned, are heard over wider areas, are both, inspiratory and expiratory, and disappear after a few weeks medical care. Pleural crepitations are dry, superficial sounding, present both during inspiration and expiration, and disappear for one or two inspirations after cough. These may be heard in many latent apical fibroid lesions in middle-aged individuals who seek advice for extra-pulmonary disorders.

The clinical signs of arrested and obsolete tubercle may include flattening and diminished expansion of one or both apices, diminished supraclavicular areas of percussion dulness (Krönig), deficient apical respiratory murmur harsh breath sounds with prolongation of expiration at the apices, some definite bronchophony and whispering pectoriloquy in the same areas, and in children, telangiectases around the cervico-dorsal spines ( $C_7$ ,  $D_1$ ,  $D_2$ ,  $D_3$ ) and elsewhere. Of these clinical signs some have been regarded as indicative of incipient and active tubercle.

Pièry ascribes the diminished respiratory murmur to pleuritic adhesions ; interrupted breath sounds to roughenings or irregular thickenings of the pleura ; but there are other causes in addition. Harsh breath sounds are considered by the same authority to be due to disseminated nodal fibrosis with emphysema. In any case, many of the above signs are certainly inapplicable to the real beginning of pulmonary phthisis, since they may be permanent and not followed by râles and crepitations. The radiological features observed under the above conditions also vary—diminished transparency of one or both apices (pleural thickenings or pulmonary infiltrations), weak apical breath sounds (often increased hilar opacities), weak breath sounds at base or generally (diminished traverse of one or both halves of the diaphragm, with or without adhesions).

Granular breathing may be associated locally and radiologically with an aggregation of apparently caseous, fibro-caseous, or fibroid opacities ; in many cases of slight apical bronchophony and whispering pectoriloquy there is no obvious radiological substratum ; apical mucous clicks have been found in some cases of marked perihilar lesions without apical changes on the plate (œdema ? from pressure on perihilar veins and lymphatics) ; also adhesions at the base have given rise occasionally to the clinical diagnosis of basal fibrosis. Mere catarrhal sounds, rhonchi, and sibili are not necessarily represented, since they may be due to simple congestion of the bronchial mucous membrane. The slow progressive dissemination of small discrete foci from the hilum towards the periphery is not likely to be accompanied by definite physical signs.

### *Pulmonary Tuberculosis in the Great War*

Both the French and Italian authorities have attacked the serious problem of the tuberculous soldier in a comprehensive and satisfactory manner. The latter—fortunately able to take some time in preparation—installed diagnostic centres (*Reparti di accertamento diagnostico*) to investigate all cases. Caccini (*Medical Record*, 1918)

describes that established at Rome. The Italian medical boards employed rigorous methods for the purpose of admitting men into the armies. They rightly rejected those with a history of past pleurisy, including interlobitis, with pleuritic thickenings and adhesions, the relics of past disease. At first it was thought that such men might be utilised in the auxiliary services; but inasmuch as they are only able to give a minimum of work, and are liable, under the periods of excessive mental and bodily strain imposed by military necessity, to recrudescence or to new manifestations, it was considered advisable to reject them, except under special conditions of urgency. The logical deduction is that recruits after admission must be considered free from tubercle, and that all cases of tuberculosis arising subsequently must be regarded as caused by the vicissitudes and by the fatigue of warfare. The X rays were preferred to tuberculin, and radiography fortunately took precedence over radioscopy. Stereoscopic pictures were taken in the sitting position, with the tube behind. The data were divided into (a) positive, and (b) presumptive. *Positive* evidence was arranged in four categories, viz., (1) tubercle bacilli +: (2) larynx +: (3) Tbc. —: signs +: X-ray +: (4) Tbc. —: signs —: X-ray +. Examination of the larynx is indispensable, since tuberculosis may be active in this situation and clinically latent in the lung. The radio-signs in the fourth category include broncho-pneumonia and pleurisy, followed to their possible consequences; evidence, however, which should be considered presumptive, or in which a final decision should be postponed (Author). The *presumptive* evidence falls under three sections, (1) Tbc. —: signs +: symptoms —: X-ray +: (2) Tbc. —: signs —: symptoms +: X-ray +: and (3) Tbc. —: signs —: symptoms —: X-ray +. Under section 3 the X-ray signs of peribronchitis and bronchoadenitis are included; signs which may be inconclusive and not necessarily tuberculous (Author). Soldiers exhibiting presumptive evidence were given 4-12 months leave and then re-examined. Those with minimal signs of presumptive proof were

detached for sedentary service. The French Government also established a probation centre for each army (*centre du triage*), and certain of the results have already been published. The examinees consisted of soldiers who had undergone military service and had been subsequently sent back on account of obvious or presumptive tuberculosis. Emile Sergent and Delamore, of the Paris centre, reviewed 600 cases admitted into hospital for further observation (*Journal de Médecine*, 1916). After complete examination (repeated clinical, radioscopical and radiographical, investigation of sputum, and tuberculin reactions, temperature charts, blood pressure and pulse), 14 per cent. were found to be non-tuberculous. Among these were cases of simple anæmia, emaciation, dyspepsia, of mitral disease, bronchitis, and emphysema. About 5 per cent. exhibited *nasal* lesions, with emaciation, anæmia, cough, the absence of pyrexia, of increased vocal vibrations, and of fixed adventitious sounds, with the possession of normal arterial tension. One had a foreign body in the lung, another a hydatid cyst. Many cases of nasal disease, including ethmoiditis, antral disease, hypertrophy of turbinates, the presence of spurs and deflections of the septum, are accompanied by a chronic coryza which gradually spreads downwards, leading to granular pharyngitis and bronchitis. There was a bacillary sputum in 15 per cent. which was confirmed by physical and radioscopic examination. Occasionally the latter showed intrapulmonary foci and cavities which the stethoscope was unable to disclose on account of their central and deep situation, or on account of accompanying bronchitis and thickened pleura. In 70 per cent. of the suspects the changes were apical, and in about 50 per cent. tuberculosis was active. The presence of parenchymatous apical changes was shown by dulness on percussion, increased vocal vibrations, crepitations, hæmoptysis; the apical opacity being unchanged by cough, and being accompanied on the plate by the presence of striæ and small foci. Pleural adhesions were shown by dulness





RAD. 80 (Ant.)—Perihilar tuberculosis, left hilum chiefly.



RAD. 81 (Post.)—Left perihilar tuberculosis. Cavity in axilla.

on percussion, diminished tactile fremitus, pleural friction sounds, diffuse opacity with some illumination on cough. Sergeant also gives two signs in addition, viz., inequality of pupils (affected side usually dilated) and supraclavicular adenitis due to the pleural affection. The various items of the pleural syndrome are far from being always contemporaneous, and their duration is as variable as their frequency. "Les frottements sont très précoces et très fugaces : ils traduisent la présence d'*exsudats* perméables aux rayons X et caractérisent la période initiale, *purement stéthacoustique* de la pleurite apicale . . . les *voiles* qui résultent de l'organisation des adhérences conjonctives sont plus tardifs et plus persistants ; ils caractérisent la phase terminale, *essentiellement radiologique*, de la symphyse du sommet." These statements lack anatomical verification. Delherm and Kindberg (*Journal de Radiologie et d'Electrologie*, 1917), made observations on one thousand cases at a probation centre in France, but their results are scarcely reliable, since they considered that it is necessary in every case to place in evidence the bacilli of tubercle, and by the fact that radioscopy alone seems to have been employed.

## REPORTS OF CASES ILLUSTRATIVE OF PRECEDING STATEMENTS

### A.—Hilar, Perihilar, and Interlobar Lesions

1. James S—, æt. 22. Cough, hæmoptysis, 3ii fourteen days ago : Tbc + : family history +. *Signs*: crepitations at both apices, scattered rhonchi. *Radiogram* 80 : both hilar opacities increased in size, and irregular in outline: right paratracheal opacity: thickening and dilatation of bronchi, especially in upper left lobe, some diminished transparency along both axillary lines: infiltration of left perihilum: small subclavicular foci on both sides, emphysema.

2. Caroline H—, æt. 20. Enlarged tonsils, especially right: mouth breather: cough nine months: expectoration since influenza six months ago: hæmoptysis, an occasional staining: no night sweats: Tbc.—: t° subnormal. *Signs*: left isthmus diminished: granular breath sounds, some rough breathing and diminished expansion, and occasionally a few crepitations at left apex. *Radiological*: diaphragm sluggish, left hilar opacity much enlarged, diffuse grey, and branches running to left upper lobe thickened: median microcardia.

3. Irene S——, æt. 30. Cough, night sweats, emaciation, marked anæmia. *Clinical signs*: fixed catarrhal sounds and slight clicks at left apex: breath sounds weak at the right base. *Radiogram*: left hilar opacity increased in size, with a few suspicious perihilar nodes between it and left apex.

4. John M——, æt. 13. Expectoration —: wasting +: hæmoptysis —: looks ill: left chest —, dulness to percussion: no other physical signs. *Radiogram*: left hilum enlarged with an indefinite periphery: thickened bronchi and congested vessels running to left apex: costophrenic adhesion at cardiac apex: right hilum enlarged, bronchi running to left base thickened.

5. Nellie F——, æt. 21. Cough three months, expectoration: Tbc. +: night sweats: pain between shoulder blades (interlobar?):  $\dagger^{\circ}$  97-100°. *Physical signs*: indefinite. *Radiogram*: right upper interlobar infiltration, which yields dulness to percussion: bronchial breathing and inspiratory crepitations on auscultation—fissure not examined until after the radiosopic examination.

6. Daisy D——, æt. 26. Cough and pain left side for six weeks: sputum +: Tbc. +: emaciation slight. *Physical signs*: movement and percussion not diminished left: breath sounds feeble, no crepitations: at left apex breath sounds rough. *Radiogram* 81: cavity in subaxillary region on left: a few infiltrations between it and left hilum. Cases like this are not uncommon. They may leave the sanatorium improved and *without* bacilli in sputum: but when the lobe containing the cavity, or one of the other lobes, exhibits what is apparently a spray of congested vessels, small hæmoptyses (3i) occur with change of barometric pressure, slight unaccustomed exertion, and in association with menstruation (P. congestiva). The cavity is not usually visible on the anterior plate.

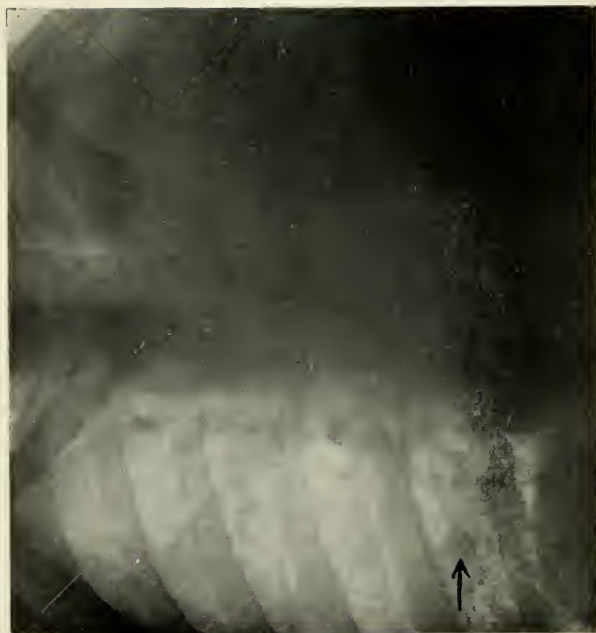
#### B.—Apical Infiltrations with or without Excavations (on Radiogram)

1. Isabella——, æt. 20. Cough, expectoration, no hæmoptysis, dyspnœa, wasting, night sweats, family history positive: *Clinical signs*: at left apex diminished movement, feeble breath sounds, no crepitations. Tbc. negative (9 times). *Radiogram*: left upper lobe striated in appearance, a small caseating node in left supraclavicular area: slight left lateral microcardia.

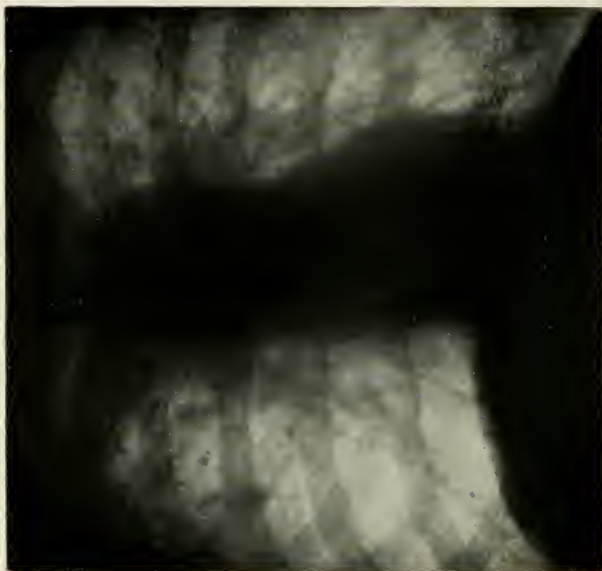
2. Elizabeth J——, æt. 40. Cough, sputum staining: chronic cough since attack of pleurisy and hæmoptysis five years ago:  $t^{\circ}$  normal: *Clinical*: left lung, diminished expansion and crepitations left apex. *Radiogram*: infiltrations in left upper lobe reaching as low as second rib, containing small excavations.

3. Thomas D——, æt. 37, ex-soldier. Gunshot wound left lung, cough, expectoration, hæmoptysis, wasting, dyspnœa. *Clinical*: breath sounds feeble left base, no adventitious sounds, vocal fremitus increased. *Radiogram*: fracture of left ninth rib: thickenings





RAD. 82 (Ant.)—Extensive fibrosis and thickened pleura left lung, (?) syphilitic.



RAD. 83 (Ant.)—Fibroid infiltrations both apices. Broncholiths in upper lobes. Aortic dilatation.

of pleura and induration of lung in the vicinity: infiltration at left apex, apparently old, at level of osseous extremity of first rib. The symptoms seem due to the traumatism: the apical lesion has not been roused into activity.

4. Morris L——, æt. 46. Pleurisy eighteen months ago: cough for years, sputum frothy, hæmoptysis fortnight ago, emaciation: family history —. *Physical signs*: slight and indecisive. *Radiogram*: an infiltration in right first and second interspaces, outer half: no excavations: right paratracheal opacity: microcardia, slight, lateral and to right.

### C.—Disseminated Lesions

1. Amy G——, æt. 29. Began to be ill three months ago: flattening and diminished expansion left side: signs indefinite: Tbc. + : *Radiogram*: disseminated nodular in both lungs, apparently mainly fibrotic: tendency to aggregation at apices: dilated thickened tubes at bases.

2. Albert J——, æt. 18. Cough one year, recently left pleurisy. *Signs*: crepitations behind at inferior angles of scapulæ, dullness at left base. *Radiogram*: disseminated nodal opacities in right middle and basal lobe: thickenings of right upper interlobe: pleuritic residues at left base and cardiophrenic adhesion.

3. Edward R——, æt. 33. Cough for years, severe influenza fifteen and again ten years ago: cough, hæmoptysis on three occasions: crepitations and rhonchi in right lung. *Clinical diagnosis*: bronchitis(?). *Radiogram*: disseminated nodular phthisis in both lungs, becoming fibrotic: mediastinal deviation to the right: some dilated tubes in right upper lobe.

4. Joseph P——, æt. 44. Cough and expectoration for months: no hæmoptysis: emaciation. *Clinical signs*: impaired resonance at left apex, a few rhonchi, toneless heart sounds. *Radiogram*: disseminated foci and small cavities left upper lobe, nests of small foci lower down: shrinking of left upper lobe: central microcardia.

5. Solomon F——, æt. 46. Severe anorexia and emaciation four years ago: occasional pyrexia 100°: no physical signs. The Radiogram shows a widely spread crowded distribution of very small foci in both lungs: supraclavicular apices free: ossification of first rib cartilages.

### D.—Chronic Infiltrative Fibroid Lung

1. Catherine E——, æt. 33. Cough, dyspnœa, tachycardia, dyspepsia. *Signs*: general dullness to percussion over left side, breath sounds and fremitus diminished, in places breath sounds tubular. Systolic bruit at cardiac apex. *Radiogram* 82: left chest homogeneously opaque, excepting a darker shadow, only seen in

view box, at level of fifth interspace: lævo-trachea: mediastinum and heart slightly to right: emphysema of right lung: nipple shown—arrow: shrinking of interspaces on left, old foci in right lung: diagnosis lies between pure pleuritic fibroid lung and post pleuritic fibroid tubercle. Wassermann test not employed.

2. Albert C——, æt. 52, glass worker. Cough, expectoration, dyspnœa. B.P. 180/95. Left side flat, tubular breath sounds, coarse crepitations and clicks. *Clinical diagnosis*: aneurism or tubercle (?). *Radiogram*: opaque patch outside left hilum reaching to axilla, and a thin opacity reaching as far as left diaphragm from lower part of hilum. *Rad. diagnosis*: pure fibroid (dust ?).

3. Lily C——, æt. 39. First husband and one daughter died of phthisis: cough, Tbc. —: t° subnormal but variable. *Signs*: crepitations both apices. *Radiogram*: fibrosis of lower right and middle lobe: emphysema: dilated right auricle. (Conjugal tubercle is not uncommon; it is often perihilar, of minimal activity, or arrested.)

4. Morris M——, æt. 45, boot-laster. Movement on right side impaired: harsh breath sounds: bronchial breathing: dull cracks in front and back of upper right: *Clinical diagnosis*: fibroid consolidation right upper and lower lobes, and left upper. *Radiogram* 83: consolidation reaching from mediastinum to right axilla at level of second rib: right supraclavicular area opaque: microcardia: dilatation of ascending aorta and sclerosis.

#### E.—Midlobar Fibrosis

1. Louisa W——, æt. 30. Cough, expectoration slight, wasting, flushed face. *Signs*: percussion impaired on right, especially middle lobe: Tbc. —: *Radioscopy*: diaphragmatic movement on right minimal, inspiratory tremor only: *Radiogram* 84: disseminated nodular fibroid, especially affecting right middle lobe.

2. Emily G——, æt. 28. Cough, sputum, no hæmoptysis: t°97·6°: *Clinical*: diminished movement, breath sounds feeble, no crepitations on right side. *Radiological*: right hilum enlarged, with infiltration extending into middle lobe: some deviation of mediastinum to left. Tuberculosis or unresolved pneumonia?

3. A—— B., æt. 33. Cough one year, expectoration streaked: Tbc. —: *Clinical*: movement and percussion note impaired right apex: granular breath sounds in hilar region posteriorly. *Radiogram*: fibrosis middle lobe, and heavy hilar opacity.

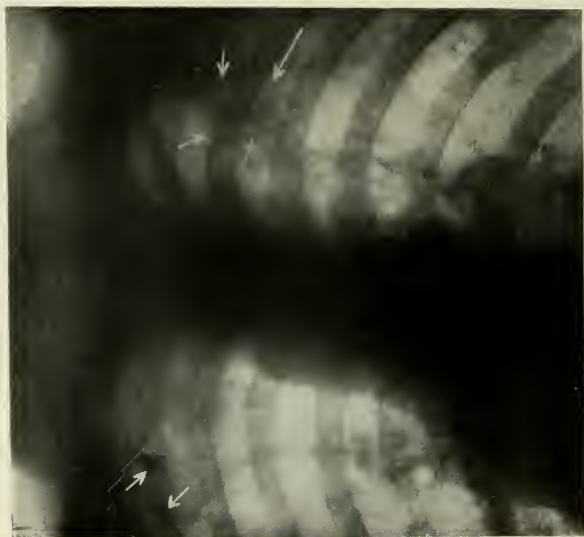
#### F.—Pleuritic

1. Henry T——, æt. 36. No cough, no hæmoptysis, night sweats +: dyspnœa +: *Signs* indefinite: *Clinical diagnosis*, tubercle?: wife has pulmonary tubercle. *Radiogram*: slight pleural adhesions in left axillary line: thickenings at left apex: left chest contracted: no signs of pulmonary involvement.





RAD. 84 (Ant.)—Disseminated nodular fibroid phthisis right middle lobe. Microcardia. Left lateral.



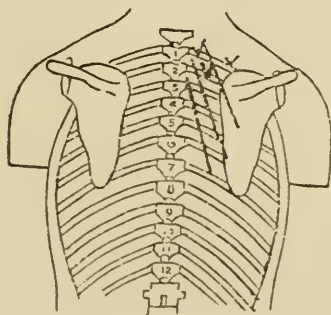
RAD. 85 (Post.)—Apical fibrosis right lung with chronic bronchitis.

2. Sidney P—, æt. 29. Cough, dyspnœa, night sweats, hæmoptysis a staining: finger nails incurved:  $t^{\circ} 97-98.4^{\circ}$ . *Signs*: indefinite, no moist sounds. *Radiological*: right leaflet of diaphragm sluggish: a visceral pleuritic shadow running parallel to diaphragm is revealed in radiogram taken in deep inspiration: slight pleuritic general thickening over right lung: a few scattered foci in pulmonary fields: central microcardia.

### G.—Bronchitic and Bronchiectatic

1. Alfred W—, was in sanatorium, 1912, for fifteen weeks, then said to have bacillary sputum: no hæmoptysis. *Signs*: on left, percussion note impaired at apex, a few moist sounds, heart apex more to left than usual. *Clinical diagnosis*: fibrosis of left lung. *Radiogram*: diffuse cylindrical bronchiectasis in both lungs only: (non-tuberculous?).

DIAGRAM 7.

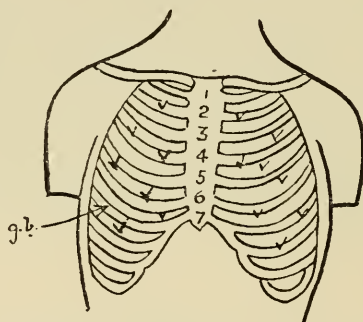


2. Edward W—, æt. 45, carpenter. Bronchitis three years ago, never free since: cough, expectoration, no hæmoptysis: night sweating: effort dyspnœa: no emaciation: no clubbing: Tbc.—: *Clinical*: percussion note impaired right apex, distant rhonchi, and a few post-tussive crepitations right apex posteriorly (Diagram 7). *Radiogram 85*: patch of aggregated foci at right apex with an area of dilated bronchi surrounding it: slight emphysema: microcardia and cardioposis. (Bronchitis tuberculosa.)

3. Elizabeth C—, æt. 38. Pleurisy as a child, bronchitis every winter since: pneumonia eight years ago: dulness both apices and crepitations (12.6.18): moist sounds gone (30.7.18). *Clinical diagnosis*: phthisis both apices. *Radiogram*: shows a saccular paracardiac bronchiectasis of left side: streaky fields: calcification first rib cartilages. (Non-tuberculous bronchiectasis.)

4. Fanny S—, æt. 26. Cough, sputum, emaciation, pyrexia, lassitude, no hæmoptysis, family history —. *Clinical* (Diagram 8): scattered rhonchi, granular breath sounds near right nipple. *Radiogram* 86: small fibrocaseous consolidation near right nipple (arrows): scattered foci in right middle lobe and in left lung: some generalised dilatation of bronchi: paralytic thorax, slight basal emphysema: central microcardia slightly dilated: thin right paratracheal shadow (B. tuberculosa).

DIAGRAM 8.



Mrs. S—. Diffuse rhonchi; g.b., area of granular breath sounds.

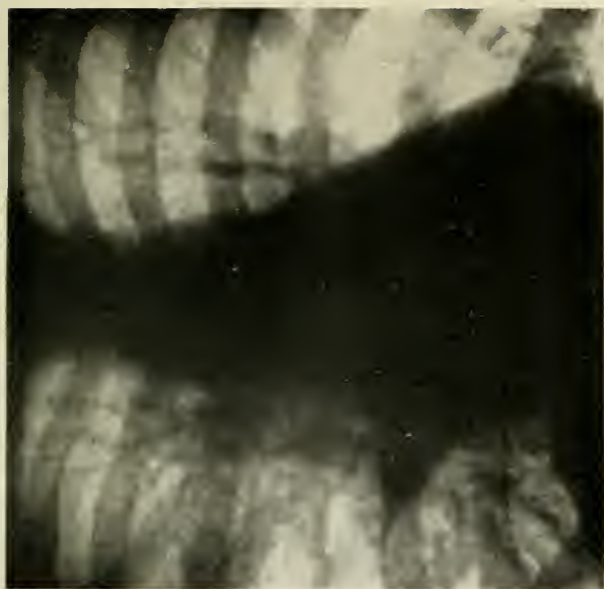
5. Henry H—, æt. 24. Has complained of cough, with copious expectoration and frequent hæmoptyses since an attack of pneumonia six years ago: no loss of weight: Tbc. —: is following the vocation of milk carrier. *Signs*: no crepitations, diminished movement of right side with emphysema. *Radiological*: diaphragmatic halves almost immobile. Radiogram shows a condition of dilated cylindrical and sacular bronchiectasis: some tubes in upper left lobe are partially filled with sputum: at the base of right hilum a triangular patch of unresolved pneumonia? *Rad. diagnosis*: non-tuberculous diffuse bronchiectasis after bronchopneumonia. (Radiogram 87.)

6. Ada R—, æt. 41. Cough, expectoration somewhat excessive, mucopurulent. Signs of tubercle inconclusive: Tbc. —. Radiogram 88 shows a condition of purulent bronchitis (chronic influenza) with enlarged hila (sputum), distribution of larger tubes well seen: the rounded foci in periphery are tubes cut transversely, filled with secretion: note the bend of tube (arrow) just below sternal end of first rib: cardiac opacity normal. No radiological signs of pulmonary tuberculosis. (Bronchitis chronica mucopurulenta.)

7. John H—, æt. 27. Hæmoptysis, twelve times in a month: gassed three years ago (tear gas): cough, sputum: Tbc. —: no physical signs in lung. *Radiogram*: both fields filled with an in-



RAD. 86 (Ant.)—Quiescent tubercle with bronchitis.



RAD. 87 (Ant.)—Diffuse saccular bronchiectasis.



tense interlacing fibrosis, especially marked at both bases: a few calcareous nodes in right hilum (non-tuberculous bronchial fibrosis).

A discussion of the relations between bronchial asthma and tubercle must be relinquished for the present.

#### H.—*Partial Miliary Dissemination*

1. Eleanor O——, æt. 22. In-patient, then in sanatorium five years ago: no cough, no sputum, no hæmoptysis. *Signs*: movement at right apex diminished and expiration prolonged. Is at work, but feels very tired and languid:  $198\cdot4^{\circ}$ – $99\cdot6^{\circ}$ . *Radiogram* shows old healed (?) infiltration at right supraclavicular apex: and a shower of very small foci in the right axilla, apparently more recent (minimal activity with slight pyrexia and lassitude?): central microcardia: emphysema.

#### K.—*Exophthalmic Goitre*

1. Sylvia E——, æt. 20. Enlarged thyroid, cough night and morning: expectoration: sweating sometimes: at right apex percussion note impaired: expiration prolonged, rhonchi right base. *Radiogram*: right paratracheal opacity: opacities outside right hilum: irregular right phrenic leaflet, supraclavicular apices clear: dilated right auricle.

2. Sarah M——, æt. 23, cigarette maker. Cough three weeks, expectoration copious: slight swelling of thyroid, slight exophthalmos and tremor of hands: crepitations at left hilum posteriorly: systolic hæmic murmur. *Radiogram*: considerable perihilar dissemination, especially on left, and enlarged paratracheal glands.

The relations between tubercle and Graves' disease are still obscure. Radiological examination in 1915 and 1916 of twenty cases in young women sent up for X-ray treatment showed paratracheal opacities as a general rule, increased hilar opacities, and occasionally the signs of a massive general infection. When the salient features of the disease, as the exophthalmos, the tremor, and cervical swelling are less obvious, certain symptoms, as the cough, occasional bursts of perspiration (which are, however, diurnal), the oscillations of temperature, the dyspnœa, tachycardia, emaciation, may suggest incipient phthisis. Moreover, in many cases of chronic phthisis, a recrudescence of the disease may be accompanied by a fresh outburst of adrenalism. Possibly certain facts to be obtained from the radiogram may be useful in prognosis. With regard to the opposite condition of myxœdema, in

which it is said the resistance to tubercle is diminished, the author has little experience. In one case of chronic myxœdema after middle age, the radiogram showed both lungs filled with small disseminated fibroid foci, with a hilar infiltration at junction of right interlobe with sternum, and a cardiac opacity in which the pulmonary curve was markedly enlarged.

#### L.—*Nasal Lesions*

1. Albert E——, æt. 29. Cough, loss of voice, emaciation, pharyngitis, deflected septum, chronic rhinitis, rhonchi in chest. *Radiogram* : right supraclavicular apex dull: in left chest a few old opacities: no signs of active tuberculous disease. Obviously the cause of the cough and slight emaciation is the chronic rhinitis with pharyngitis, and the gradual downward involvement of the larynx and larger bronchi.

*Incipient Pulmonary Tuberculosis.*—In cases which are diagnosed clinically, incipient or early, radiological examination often reveals the existence of one or more indurated, even calcareous arrested lesions either in the apex, or in the hilum and its vicinity. The clinical signs are really due to the resuscitation of a dormant lesion or to the incidence of a new infection—usually the former. On the other hand, when the disease is really incipient, the radiological manifestations may be meagre and indifferent. But such an event is really unique; as a rule a lesion which is incipient to the clinician is already progressive to the radiologist. There are three principal localities in which radiology may find the first signs of pulmonary tubercle, viz., (1) the supraclavicular apex, (2) the hilum, and (3) the paravertebral triangle.

(1) *The supraclavicular apex* or apical triangle. In order to delineate clearly doubtful lesions in this area, it is advisable to take special plates of the posterior apices, stereoscopic by preference. The X-ray tube should be soft, and slightly elevated towards the head, so as to throw the clavicles downwards, and to give an unobstructed view of the second and third posterior interspaces. Opacities present in this situation may be produced by old arrested fibroid lesions, probably containing smal



RAD. 88 (Ant.)—Bronchitis chronica mucopurulenta.



RAD. 89 (Post.)—Supraclavicular tuberculous foci.



cavities, of the size of a pea and of the shape of a clover-leaf; by calcareous, caseating or fibroid nodular lesions; by diffuse or irregular pleuritic thickenings and small calcareous pleural plates, often linear and lying horizontally. They may be due to opacities lying externally to the pleura, such as accumulations of adipose tissue, or thickened subcutaneous or muscular tissue, to scleroderma or indurated and calcareous lymphatic glands lying in the supraclavicular fossa. Stereoscopic radiograms place each opacity at its proper level, and recognise the presence of slight scoliosis. In most cases the foci are arrested and of no serious importance.

Recent apical lesions are seldom susceptible of verification by autopsy. Radiogram 89 shows several foci, about pin-head size, in each second interspace. The general transparency is not affected. On the right they are rather more numerous; on the left they are somewhat larger and more distinct. *Post-mortem*: in both spaces several caseous foci were found, on the left some were indurated and larger. Apical pleura on each side intact.

(2) *The hilum*.—In the great majority of cases pulmonary tubercle appears to take its origin from the central glands. These have been described in Chapter II. Disease in this situation leads to an irregular configuration of the hilar opacities, often the right alone, and to an increase in breadth. If merely hypertrophied there may be only a faint greyish increase of shadow; distinct rounded shadows within the hilum may be caseating, fibroid (anthracotic), or calcareous glands according to the degree of opacity. Caseating paratracheal glands appear as convex opacities in the two anterior interspaces, or as an opacity parallel to the sternum. When the area between the right hilum and cardiac opacity, which is usually translucent, becomes opaque, the latter is often due to caseating bifurcation glands on the lower border of the right extrapulmonary bronchus. With regard to the hilum itself, care must be taken not to diagnose tubercle because of an increased

shadowing of the hilum only, since this may occur in association with pneumonia, bronchopneumonia, influenza, pertussis, and measles; also in simple chronic bronchitis, aneurysm of the aorta, and in passive pulmonary congestion from morbus cordis; it may be due to the inhalation of dust, so that oppidans do not exhibit normal hila, and particularly those who work habitually in a dust-laden atmosphere (pneumoconiosis); in children under fifteen, since anthracosis do not occur before that age, heavy hilar opacities are to be viewed with suspicion unless there are other positive circumstances to account for them. In the description of certain radiograms already given the diagnosis of hilar phthisis has been discussed, so that further remarks are here superfluous.

(3) *The Paravertebral Triangle* [enclosed by lines drawn (a) from the right hilum about the level of the vertebral end of the seventh rib to a point in the clavicle half way between its sternal end and the axillary margin of the chest; (b) along the mediastinum; and (c) along the inner clavicle] frequently contains cord-like linear opacities which are often studded with minute foci. Into the outer and upper part of the triangle the anterior end of the first rib usually protrudes; and it is in this vicinity that actual consolidations and aggregations of foci, in the first place, generally materialise, that is, within the distribution of the paravertebral bronchus. In some instances autopsy has shown that these paravertebral linear opacities are produced by fibrotic thickening of the lymphatics; in others the radiograms suggest bronchial dilatations with thickened walls, which appear invested with small round foci, generally considered peribronchial from their position; in some the leash of shadows suggests the presence of congested vessels and lymphatics. The latter may be found in congestive forms, and then often lie more external between the right upper interlobe and the axilla, and are accompanied by small frequent hæmoptyses. When the

disease slowly disseminates in all directions along the lymphatics it is usually benign, and the small foci become in time fibroid and harmless (follicular). Nodal, even larger infiltrations may be found in early cases in the paravertebral triangle, in the upper external part already mentioned, or at the periphery of the hilum and in the perihilum just outside it. The diagnosis between the two forms, follicular and infiltrative, may generally be made from the radiogram, particularly if assisted by a correct report of clinical symptoms and signs. In many cases of early tubercle apical and hilar disease are both present, but hilar changes, without apical, are more common than the converse.

Less favourite situations for the incipient development of nodules and infiltrations are the deep axilla and the vicinity of the interlobes. Considering the number of the latter type the radiologist meets, so to speak, incidentally, it is probably not at all infrequent.

*To sum up.*—The majority of incipient cases (60 per cent. at least) exhibit either minute foci ( $\frac{1}{16}$ th in. in diameter, or rather more) or minimal infiltrations, either in the upper lobe (that is, within the supraclavicular triangle, or immediately below the inner third of the clavicle), or just outside the limits of the hilum—in some instances in both situations simultaneously. These areas lie within the distribution of the paravertebral bronchus.\*

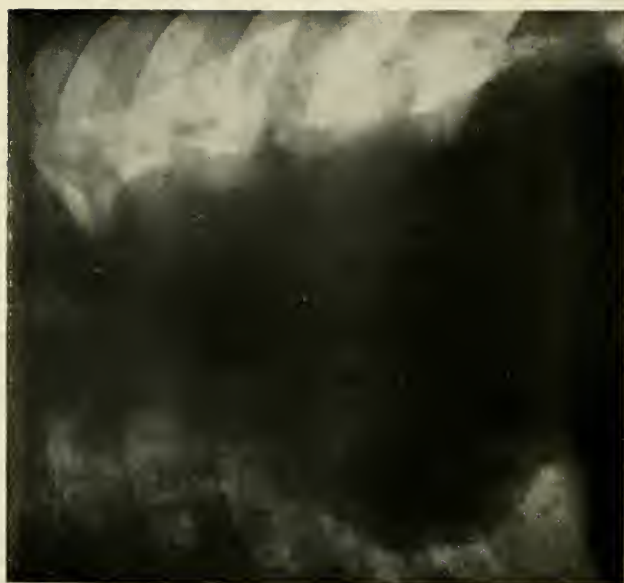
With regard to central lesions, a caseating right hilum, apparently quiescent, may re-awaken, inducing cough, wasting, and night sweats; sometimes only emaciation and a stained sputum. The author has met with cases where a diagnosis of "tuberculosis of the roots" has been made by the physician, where only cough and emaciation

\* The foci may become aggregated and form small patches of bronchopneumonic infiltration. If the opacities are of feeble intensity, with ill-defined and fluffy margins, they are *active*, with clinical symptoms and physical signs; whereas darker shadows with sharper edges indicate caseation, fibro-caseation, or fibrosis.

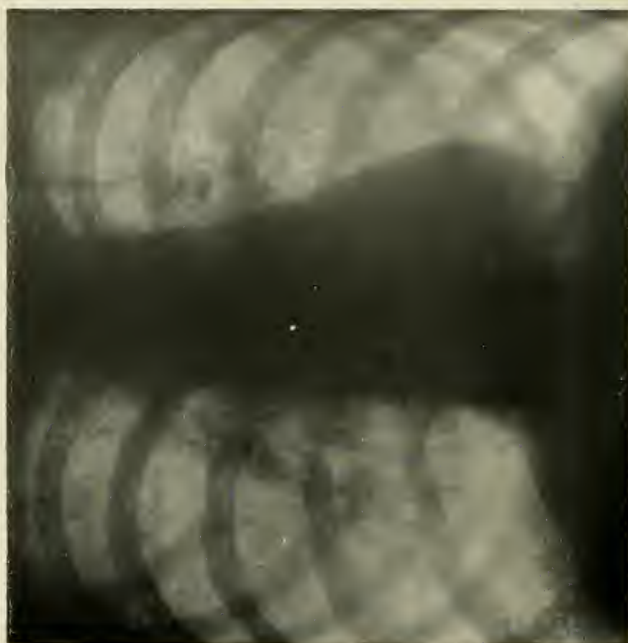
without any physical signs have been present, and in which radiology revealed increased hilar opacities merely. Hilar, or perihilar, phthisis should not be diagnosed unless a definite amount of pulmonary infiltration can be demonstrated by the radiologist, and then only in correlation with the signs and symptoms.

*In very young children* (under one year) the researches of Ribadeau-Dumas, Weil and Maingot (1912) have shown that tubercle usually begins as a small focus in the lower lobe, from which it spreads centripetally to the hilum, and then affects the paratracheal and bifurcation glands before reaching the apices. These researches do not seem to have been confirmed up to the present, although the pathological observations of Ghon (1913) prove that in children such primary foci *may occur in any part of the lung*. *In later years* (5-15) pulmonary tubercle is largely a question of central glandular disease and its centrifugal diffusion along the lymphatic tracts. At this period children appear, however, to possess a remarkable power of control over the further development of this disease, a fact probably due to the production of immunity by the primary infection. Tuberculous infection may be slight, moderate, or massive, and its degree is associated with altered radiographical signs of lymphatic dissemination. The types of tubercle in children are, (a) caseating lymphatic intrathoracic glands; (b) hilar infiltrations chiefly on right and affecting one of the upper two lobes; (c) bronchopneumonic nodular disease due to irruption from the hilum into the bronchial tree; (d) fibroid disease of axillary or apical areas, sometimes associated with pressure on root bronchi by enlarged packets of hilar glands; (e) bronchopneumonic pseudo-lobar disease springing from the hilum; (f) very occasionally extensive fibroid cavitary lesions; (g) miliary and submiliary forms. Children are often brought to the radiologist, or sent to the tuberculosis dispensary, with the suspicion or the diagnosis of phthisis, in which the lesion is either non-tuberculous or a non-





RAD. 90 (Ant.)—Aneurysm of aorta. Tuberculosis right upper lobe.



RAD. 91 (Ant.)—Thorax paralyticus. Cor pendulum, slight, left lateral. Healed tubercle.

tuberculous sequel, as it were, of an arrested perihilar tubercle. In the majority of cases it is either, (1) a central glandular disease with peripheral dissemination, which is gradually fading; (2) one of the manifestations of unresolved bronchopneumonia (cirrhosis), in the latter case often implicating the right base and right cardiophrenic cul-de-sac, accompanied by cough, wasting, basal crepitations and inferior emphysema; (3) in other cases there is a *bronchiectasis, diffuse and cylindrical*, or more or less *local* and confined to the hilum and the base. This condition requires a different form of treatment from that of hilar tubercle; if the affection does not clear the little patient may become a chronic bronchitic, although the characteristic sputum of bronchiectasis may never or may take years to develop. (*Vide* Vol. II.)

*The Radiological Signs of Arrested and Healed Phthisis*

These may be seen as (1) isolated calcareous nodes, which may be as dark as projectiles, generally rounded, sometimes oblong, and present within the hilum, perihilum, paravertebral triangle, or along the bronchi running towards the right middle lobe and bases of both lungs; (2) the inverted comma (Crane) already mentioned; (3) old fibroid and anthracotic opacities of the paratracheal, and in the right oblique position of the bifurcation glands; (4) unilateral fibroid infiltrations in the supraclavicular and upper part of the subclavicular triangle, with lighter spaces in their midst (old cavities); (5) scattered old nodal opacities which have diminished in size, increased in density, and their cloudy irregular borders have become replaced by sharp clean-cut edges; (6) occasionally slight deviations of the mediastinum towards old fibroid lesions; (7) old costal adhesions of the diaphragm, or cardiophrenic residues, and pleuritic thickenings at apex, or at axillary lines, with diminution of interspaces and dove-tailing of the ribs; (8) a scattered diffuse dissemination of small foci in young children and adults (tuberculous infection), due to lymphatic dissemination; or a more uniform distribution of

small rounded fibroid foci as the result of bronchogenic diffusion from caseating cavities ; and (9) shrinking of chest from pleuritic adhesions, and the production of a scoliosis convex to the more healthy side. In the two latter divisions some may be cases of feebly progressive fibroid disease ; (10) occasionally in the adolescent one may localise, in the external pulmonary fields, the primary focus of Ghon.

### *Associated Disease*

It has been stated that various types of pleurisy, with or without effusion, of chronic bronchitis, asthma, cylindrical and saccular dilatations of the bronchi may accompany tuberculosis. Occasionally pronounced forms of morbus cordis, prominent dilatations of the aorta, and conspicuous aneurysms may be associated with it.

Arthur H——, æt. 39, ex-marine policeman : washed down hatchway in December, 1915, kept on duty three months, then entered hospital with pain in right chest and dyspnœa. Cough commenced October, 1917, and emaciation became severe (three stone in four months) : Tbc. + : hæmoptysis, occasional streaks. *Clinical signs* : dulness right chest, bronchial breathing, short systolic at base : dyspnœa extreme : pupils and radial pulses equal : no tracheal tugging : liver enlarged, distended veins over abdomen : fingers clubbed and cyanosed. *Radiogram* 90 : cardiac opacity much enlarged towards right, dulness in right upper lobe with small excavations. The opacity was considered to be an aneurysm of the first part of the aorta. It possessed no pulsation, and it moved slightly with inspiration. The opacity became larger very gradually, finally marked pulsation became visible over the right mamma. The autopsy proved the existence of an aneurysm of the ascending aorta which had eroded several of the anterior ribs, with tuberculosis of the right upper lobe.

So much time has been devoted to the different types of phthisis that an account of the relations between this disease and syphilis, malaria, traumatism, and carcinoma must be unavoidably postponed.

*The Heart in Pulmonary Tuberculosis*

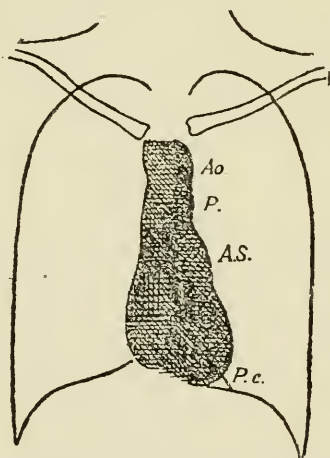
This question in reality deserves a chapter to itself; we must content ourselves with a few disjointed remarks on the subject. Radiograms 17, 24, 25, 27A, 27B, 33, 35, 38, 46, 51, 55, 57, 61, 62A, 67, 70A, 71 and 91 will demonstrate the prevalence of microcardia in pulmonary phthisis, and also that this form of heart is not necessarily limited to any one particular type of phthisis. No doubt its character is one of the causes of the low arterial tension, of the tachycardia, and of the proneness to dilate under conditions of severe strain which is exhibited, among others, by cases of disordered action of the heart in soldiers. It is frequently placed centrally in the chest, occasionally laterally (Radiogram 91). It is obvious that the prognosis in tubercle, as regards length of life, is dependent, *cæteris paribus*, on the degree of microcardia, the integrity of the aorta, their dilatability, and the extent of the muscular reserve. Moreover, cardiophrenic adhesions may be present, which render the prospect still more unfavourable.

*With regard to Diagnosis, the Association of Microcardia with Hæmoptysis is always Suspicious.* The orthodiagraphic transverse measurement may be as low as three inches but the chief point appears to be the differentiation between a normal cardiac silhouette and one of microcardia disfigured and magnified by dilatation. [The author has met with several cases of *centrally placed* hearts in late middle-aged men, who have exposed themselves continuously to increased bodily and mental strain during the war; in such individuals there has been considerable cardiac dilatation, fits of giddiness, sudden faints, slight neurasthenia, and occasionally a low arterial tension. Rest in bed for some weeks, the exhibition of digitalis, and gentle massage are required.]

The relation of microcardia to general congenital asthenia, including visceroptosis, and in particular to its variety the habitus phthisicus, appears to be intimate. Roughly, the types of microcardia may be grouped under

three headings, (1) microcardia without cardiopptosis; (2) with cardiopptosis; (3) the "hanging" heart. (Diagram 9.) In the last group there is a space on deep inspiration between the heart and diaphragm, better seen in the upright position, during which the right ventricle barely touches the central tendon. In this case the suspensory ligaments (vessels, upper pericardial and cervical fascia) hold firm.\* In some cases with marked ptosis of the diaphragm (Radiogram 91) the cardiac apex is at the level

DIAGRAM 9.



Hanging heart in woman aged 28 years, with bronchial asthma and tubercle suspect; ptosis of diaphragm. Ao., left aortic bulge; P., pulmonary curve; A.S., left auricle; P.c., pericardium visible in left cardiophrenic sulcus.

Radiogram taken in deep inspiration.

of the eleventh rib in recumbency. In this radiogram there is evidence of old arrested tubercle in the upper lobes, and severe gastropptosis was shown by the bismuth meal. On the screen the right ventricle may take part in the right vertical border of the cardiac opacity, and the right auricle may be above and behind it. Occasion-

\* The three variations may be expressed thus: (1)  $M - C - V$ ; (2)  $M + C + V$ ; (3)  $M + C < + V >$ ; where  $M$ =microcardia;  $C$ =cardiopptosis; and  $V$ =visceropptosis.

ally the hanging heart (cor pendulum) is said to produce tracheal tugging by traction on its suspensory attachments. The depth of the left ventricle, and the degree of its hypertrophy, if any, may be determined by Vaquez-Bordet's method of procedure.

### *Concluding Remarks*

The advantages of the X-ray investigation have been amply demonstrated in the preceding pages. But it should not be expected that the radiologist is able to determine at one examination the diagnosis in cases which have possibly puzzled one or more skilled clinicians. Two, even more, examinations may be necessary, and supplementary plates, ordinary and stereoscopic, of suspicious areas may be expedient. Progressive tendency and activity in the absence of definite clinical symptoms may be ascertained by observations at fortnightly intervals if required. Certain signs are special to the radiologist: the progressive studding of the bronchi in slow perihilar dissemination, the hazy outlines of an apical active infiltration, the wedge of dilated vessels or lymphatics, with its apex at the hilum, in many congestive cases: the small nodular foci in the supra-clavicular and paravertebral triangles, the unexpected diffusion of nodular foci from half-emptied cavities, the fusiform scraps and cylindrical fragments producing a broken chain from the hilum to the clavicle and axilla in forms passing into arrest and fibrosis, the circumscribed sharp edges of calcareous foci and of healed arrested fibroid patches, and the caseating opacities of the central lymphatic glands. These are phenomena which the radiologist must learn to recognise, and at the same time assign to each its proper importance and interpretation. As regards the rest, the mutual co-operation of clinician, pathologist, and radiologist is requisite in order to increase our knowledge of the disease in its incipient stages, its principal types, the life history of each, and to mature the methods of treatment and control.

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